ANNUAL REVIEW NUMBER

THE ENGINEER

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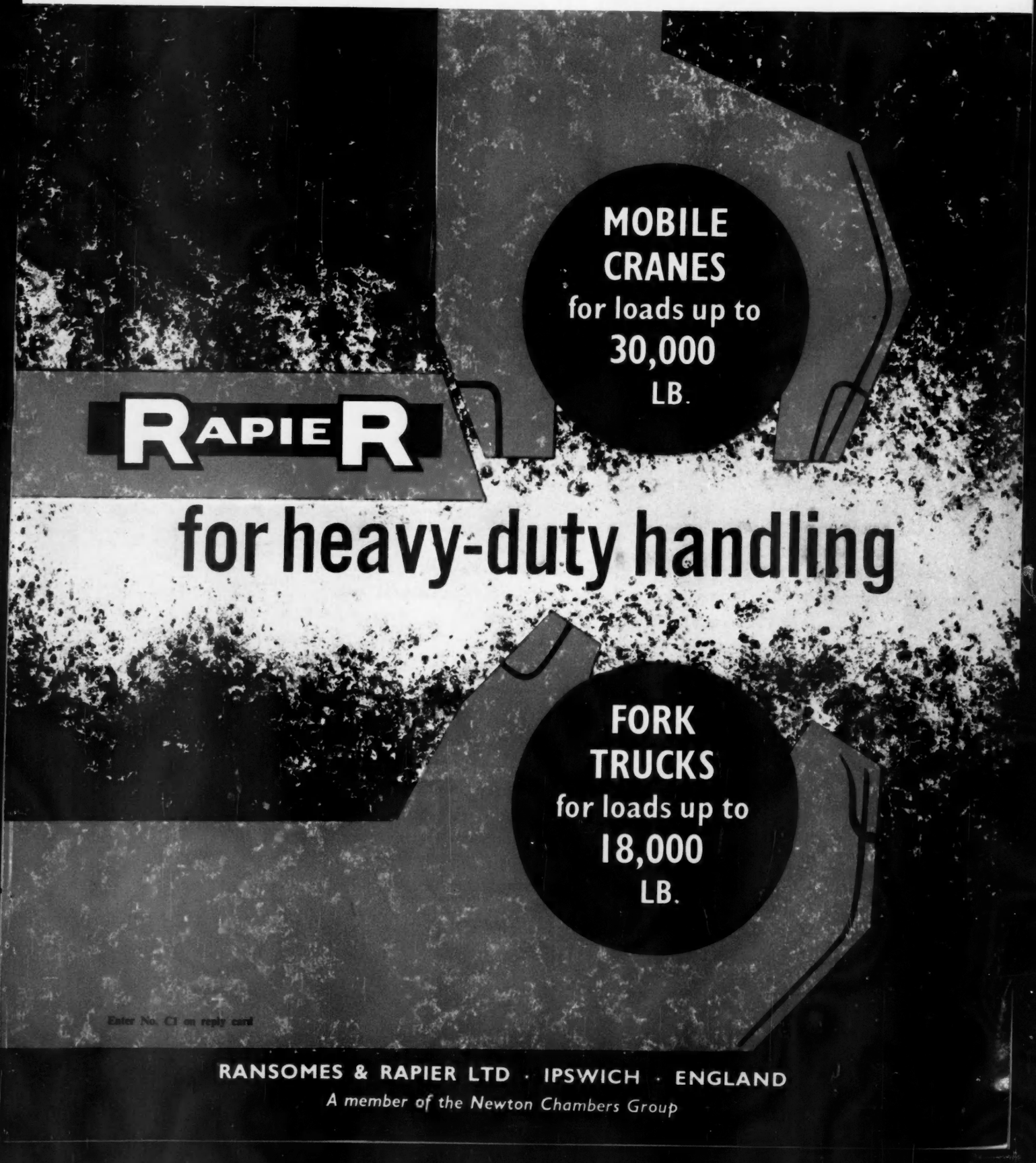

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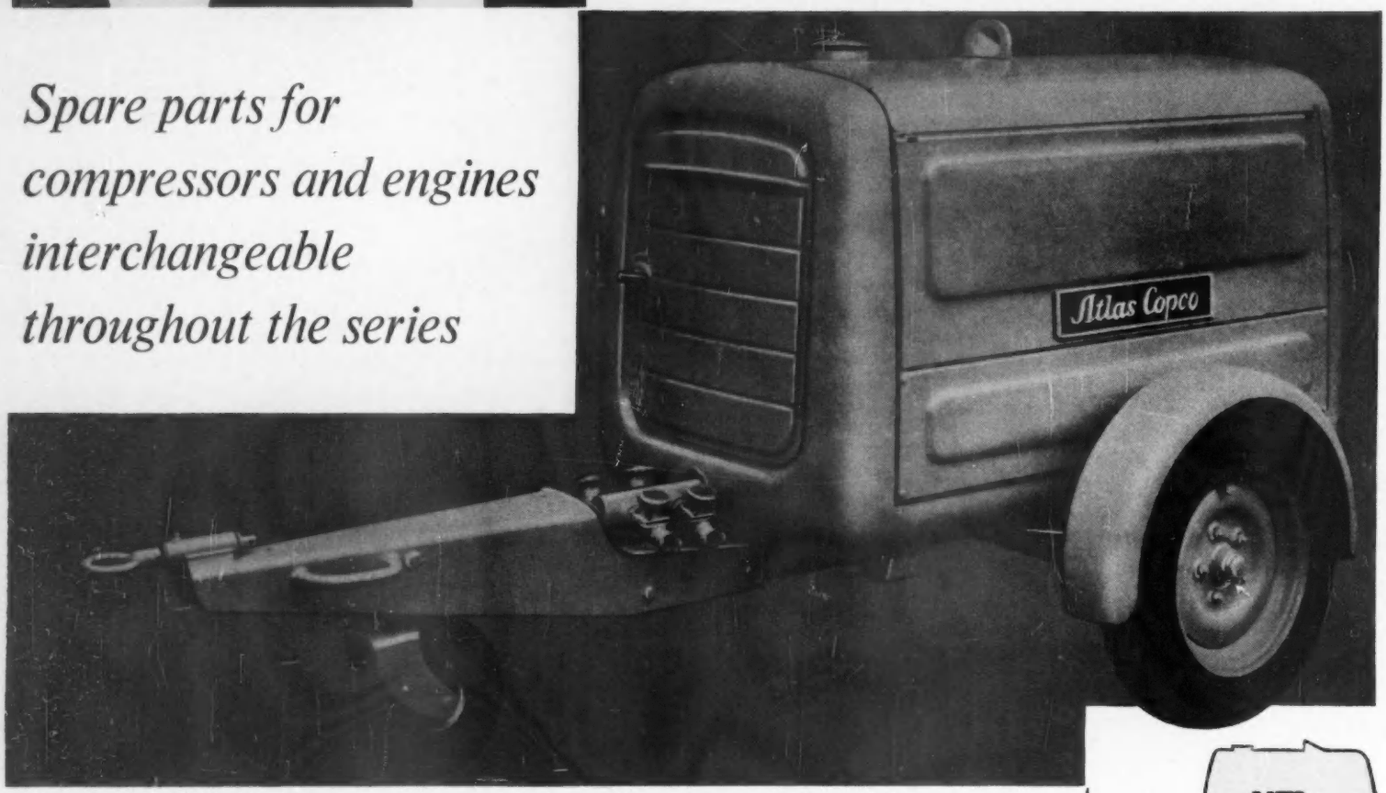

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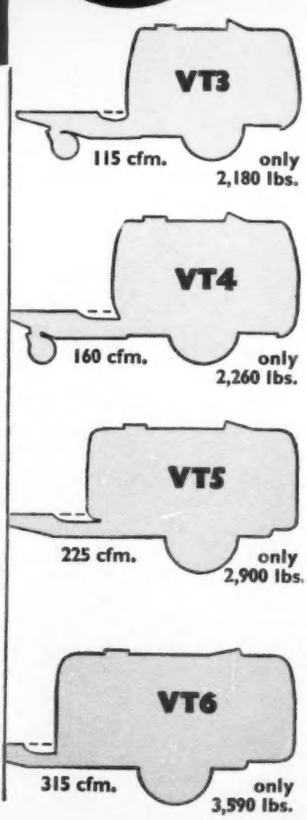

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No. 5423 **JANUARY 1, 1960** VOL. 209

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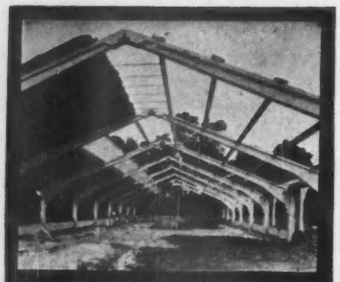

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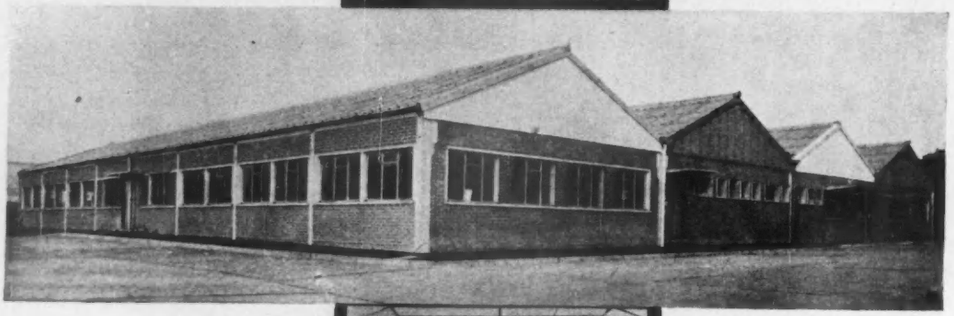

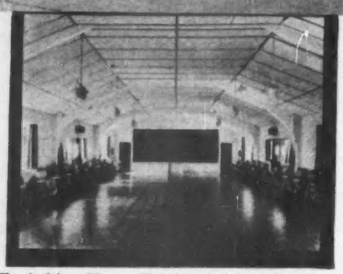

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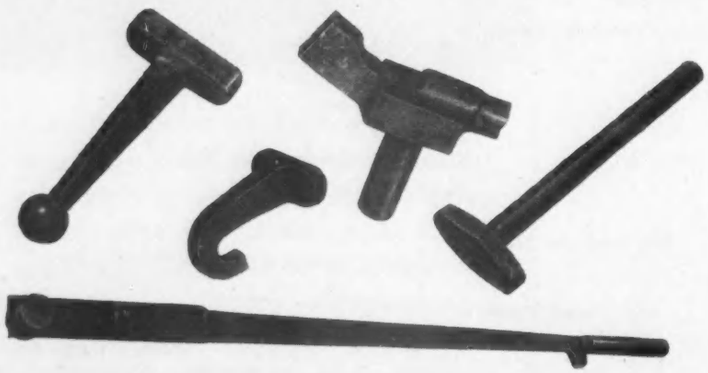

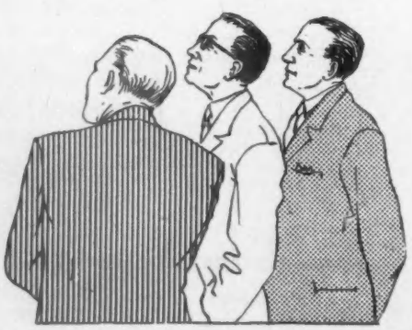

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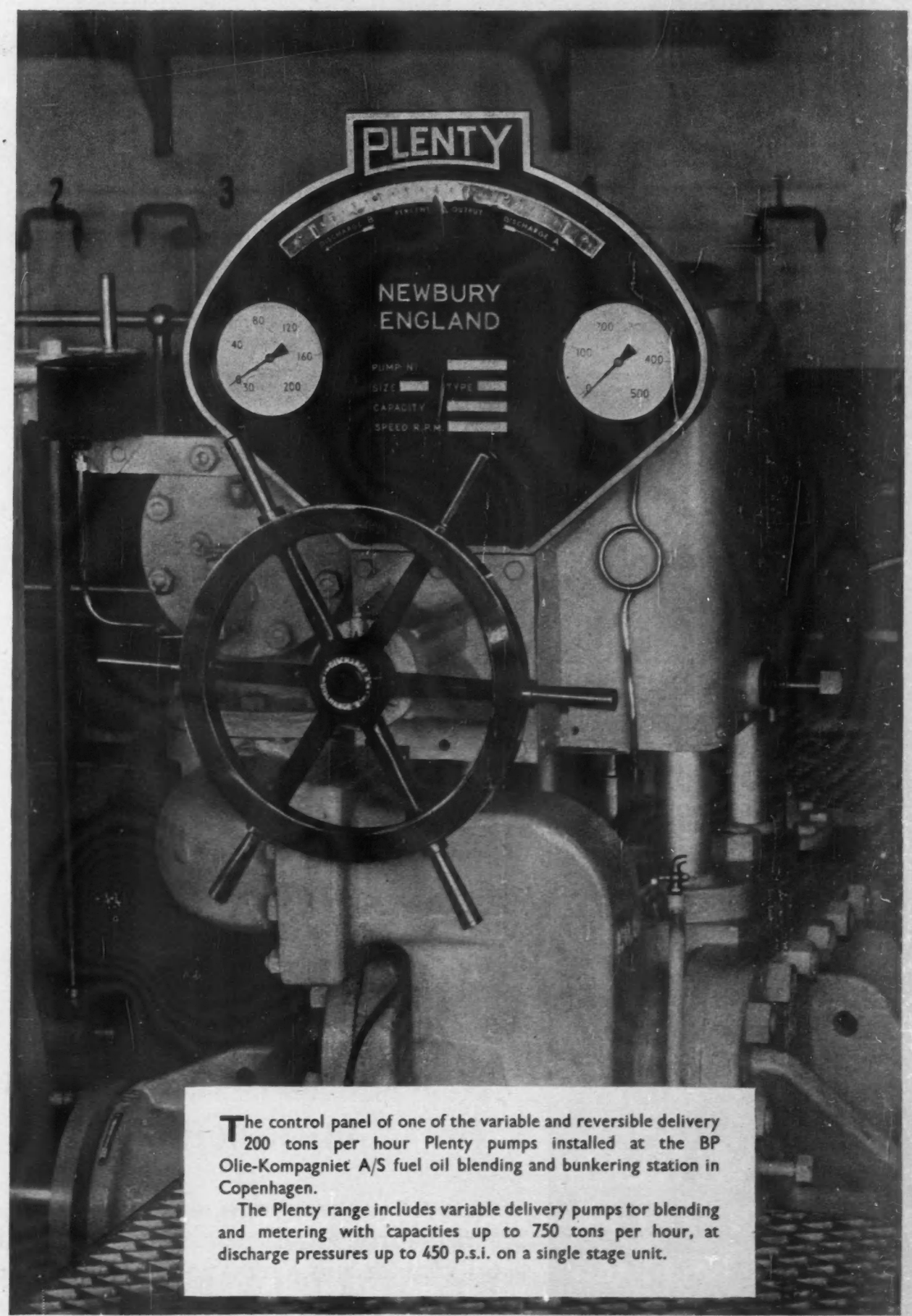

The control panel of one of the variable and reversible delivery 200 tons per hour Plenty pumps installed at the BP Olie-Kompagniet A/S fuel oil blending and bunkering station in Copenhagen.

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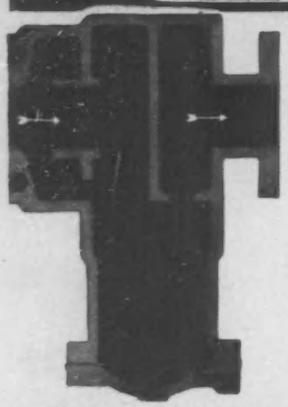

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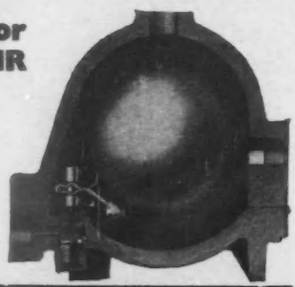

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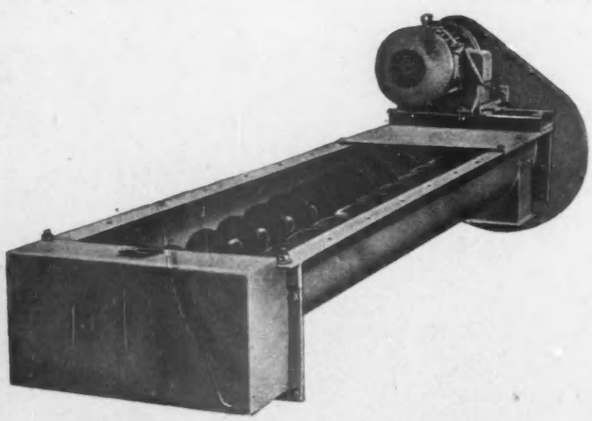

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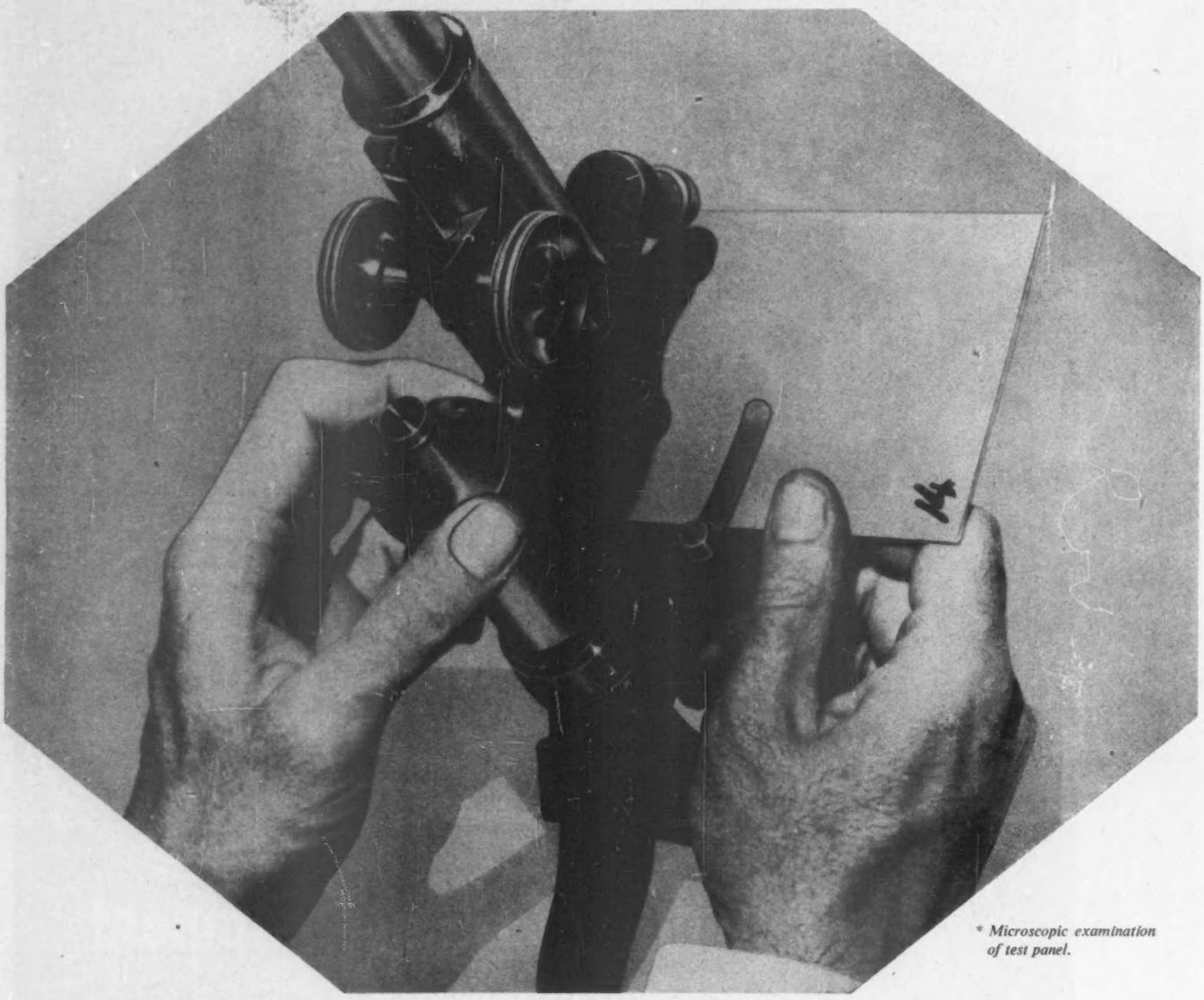

* *Microscopic examination of test panel.*

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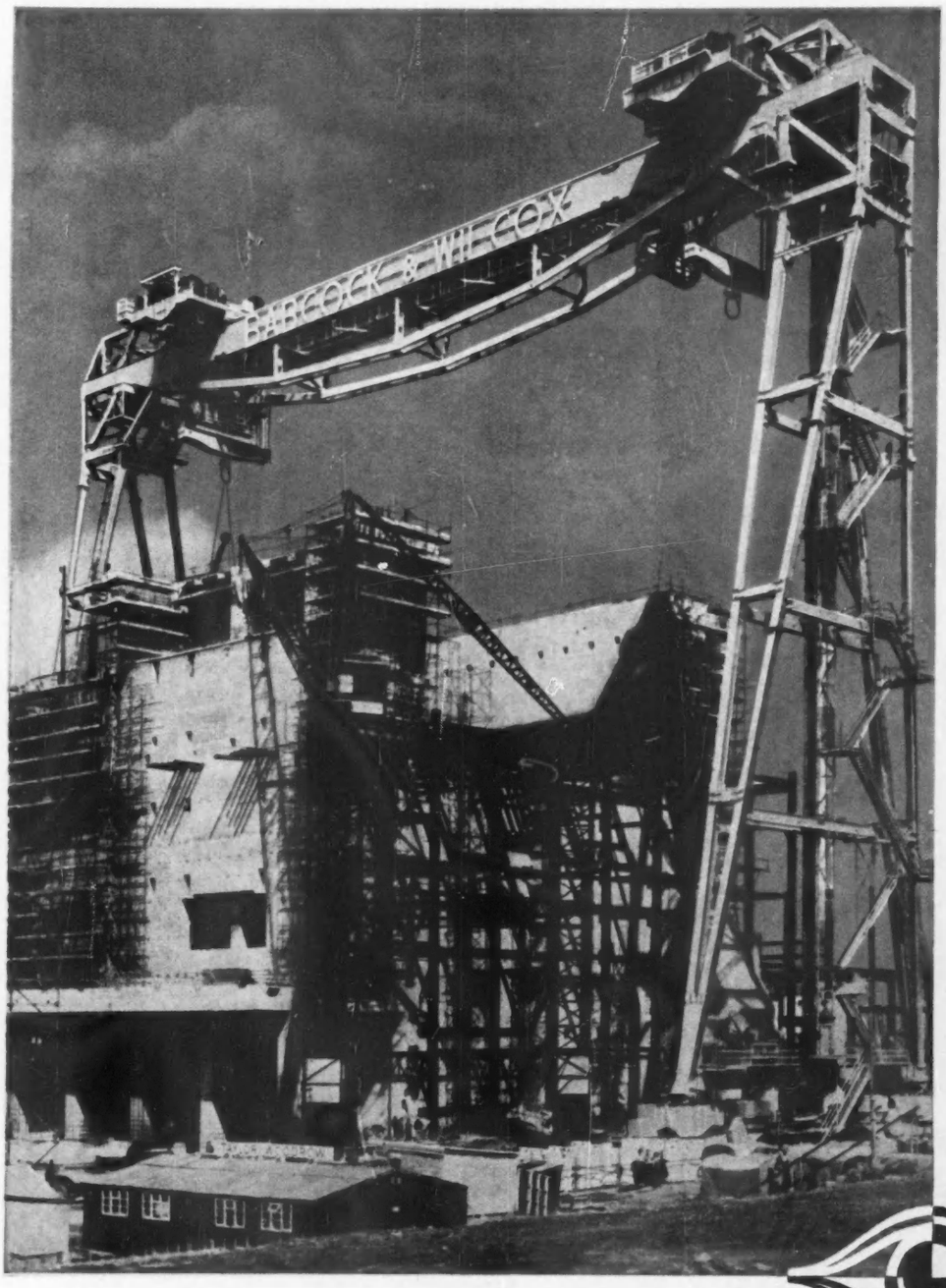

A New Look at Cranes

(Left).
Babcock 'Goliath' crane, 240 ft. high and of 250 ft. span, able to lift 400 tons to a height of nearly 200 ft. and with a "travel" of over 500 yards; shown in operation during construction of the Hinkley Point atomic power station by the English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group.

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(Above). 50 ton Babcock 'Goliath' crane, of new welded box-girder design, in operation at the Coatbridge Gas Works of The Scottish Gas Board (Main Contractors, Newton Chambers & Co. Ltd.)

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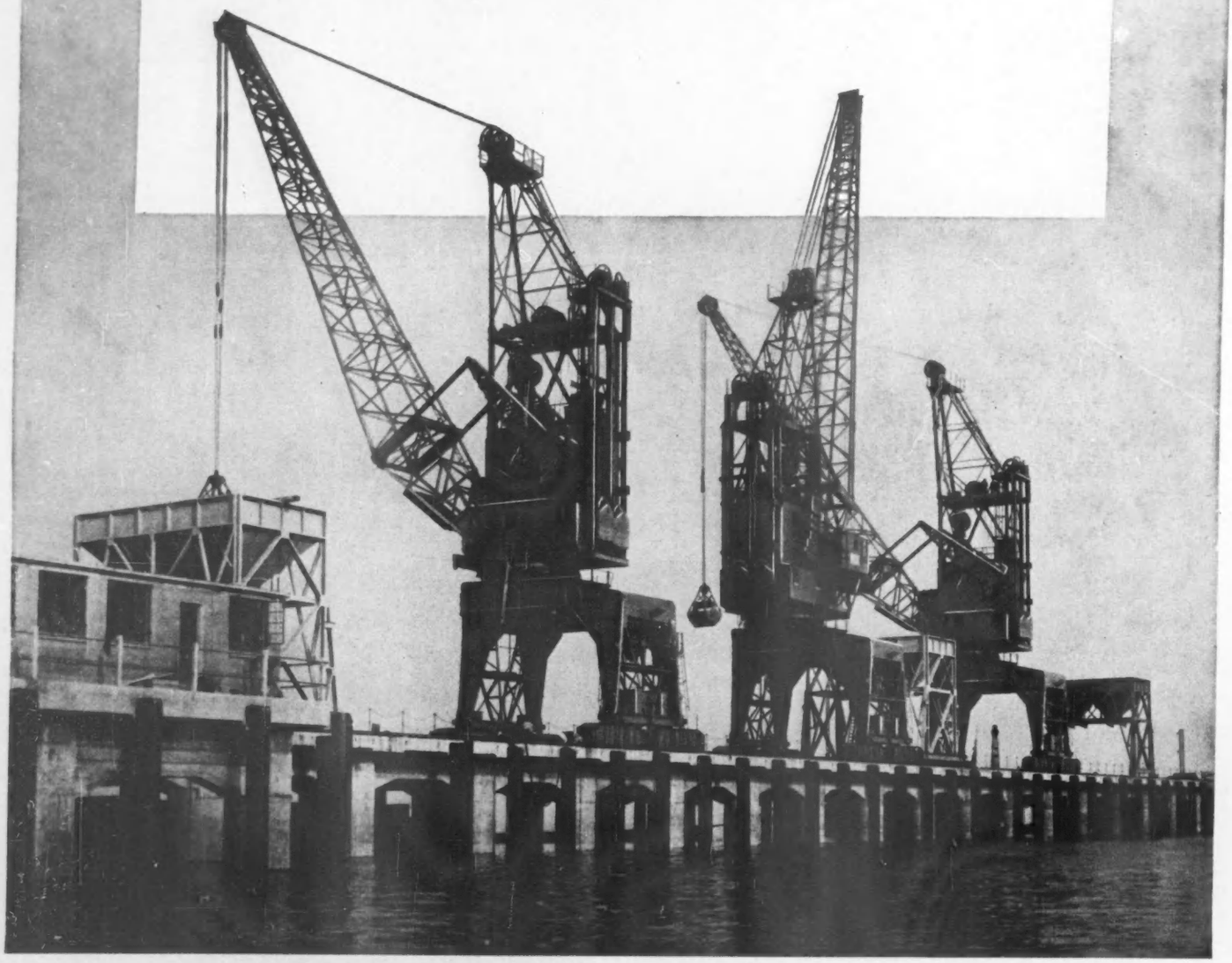

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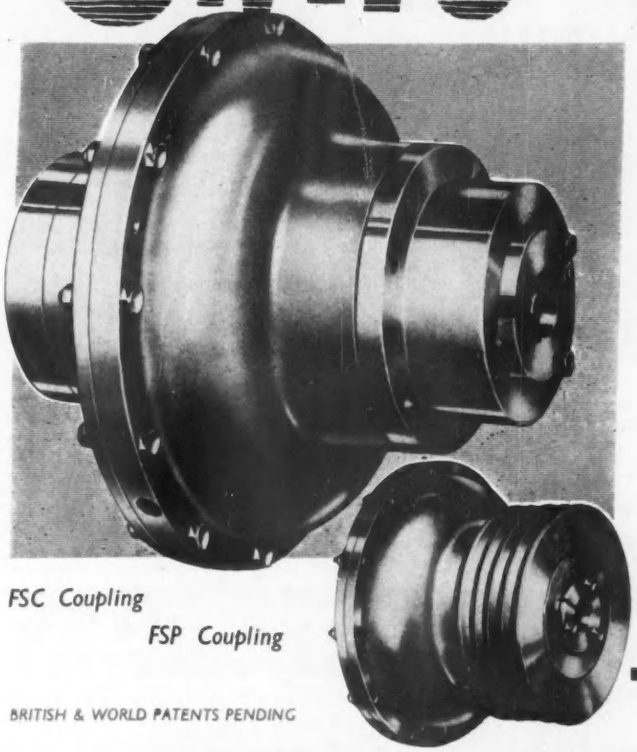

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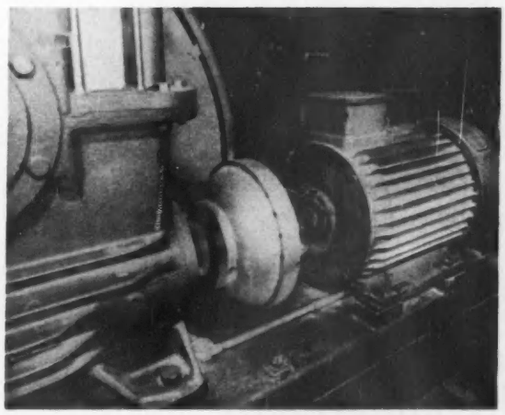

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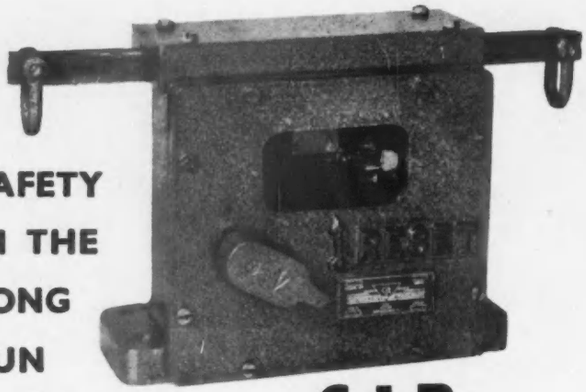

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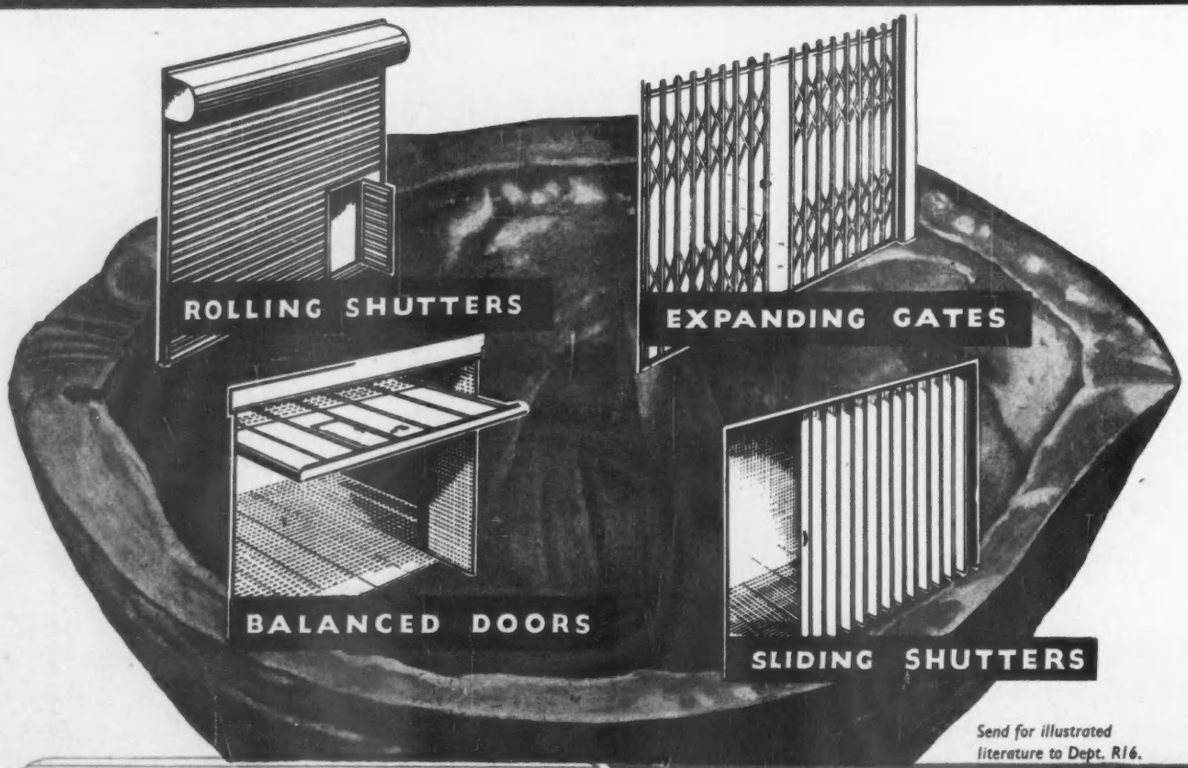

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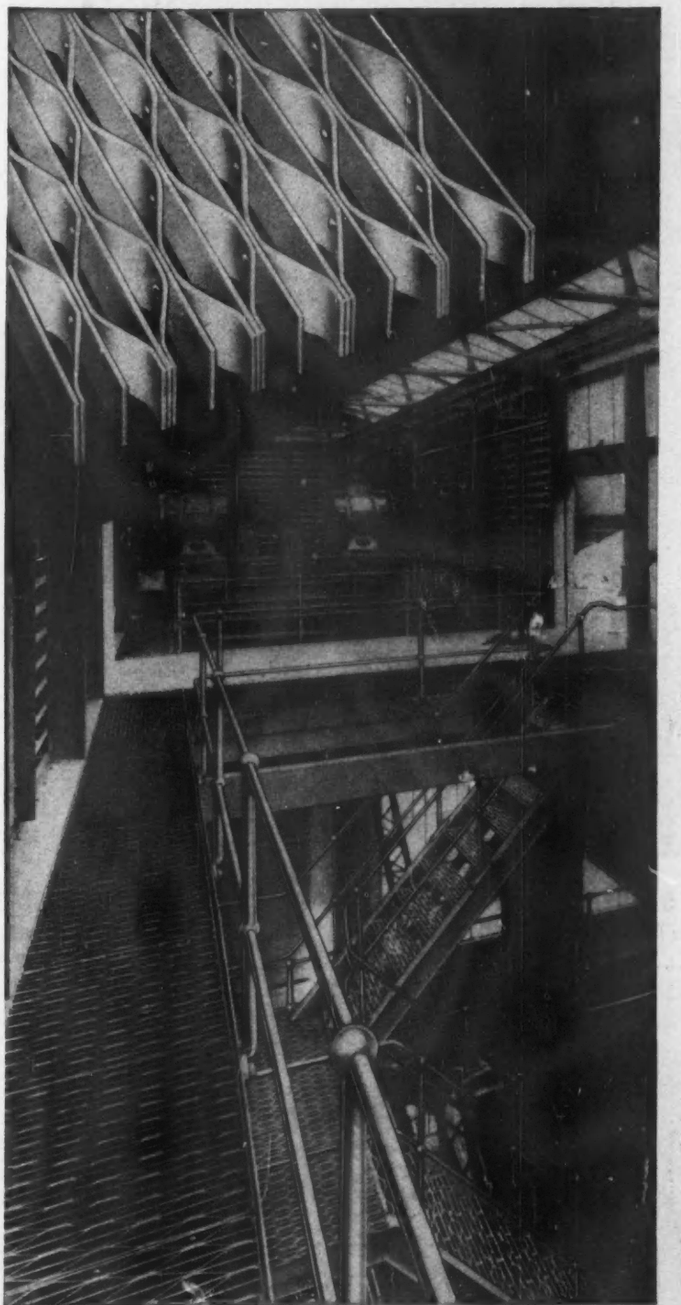

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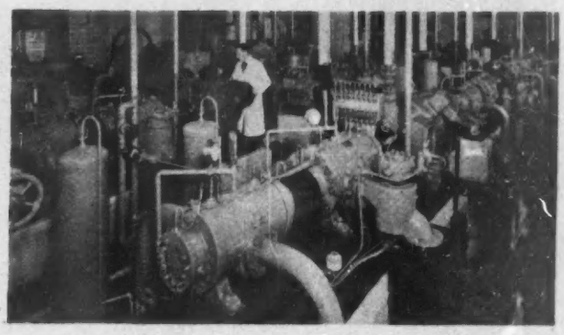

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The B. A. Holland Engineering Co. Ltd.

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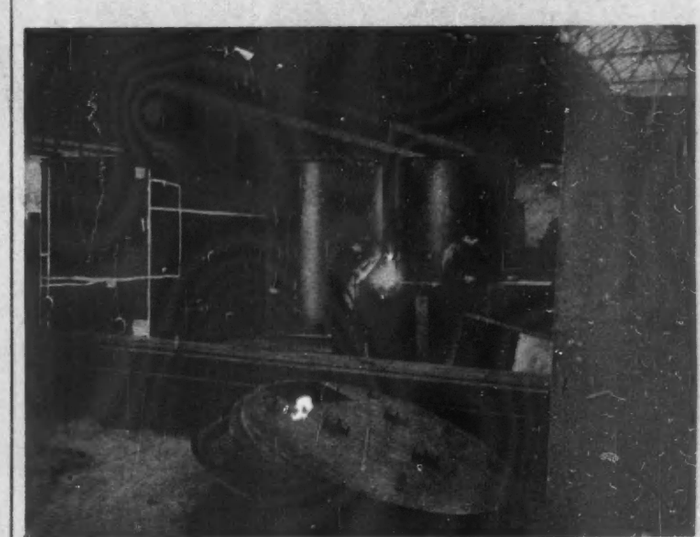

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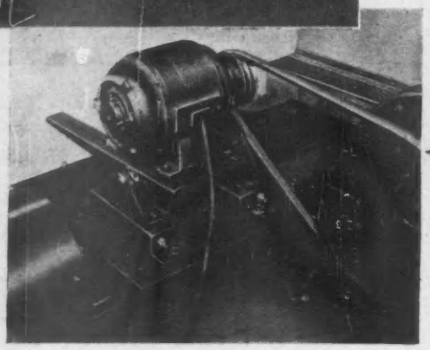
Adjusto-Slide Motor Base. Single Screw adjustment—cannot be misaligned.



Econ-O-Matic Motor Base installed on a V-belt Drive

KENYON

INTRODUCES TWO *New* MOTOR BASES

Adjusto-Slide Motor Bases have a single adjusting screw, and belt adjustment can be carried out while machinery is running, thereby eliminating costly plant stoppages. They are easy to instal, economical, and are designed to fit British Standard Motor Frame sizes.

The Econ-O-Matic Motor Base operates on the torque reaction principle and maintains the correct tension for the belt at all times. Greatly increased belt life can be obtained, and the base can be used with either V-belts or flat belts. It replaces slide rails and idlers and accomplishes all their purposes. Frequent belt adjustment and replacement are eliminated and bearing wear is reduced.

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COATED ABRASIVE PRODUCTS FOR ALL METAL TRADES

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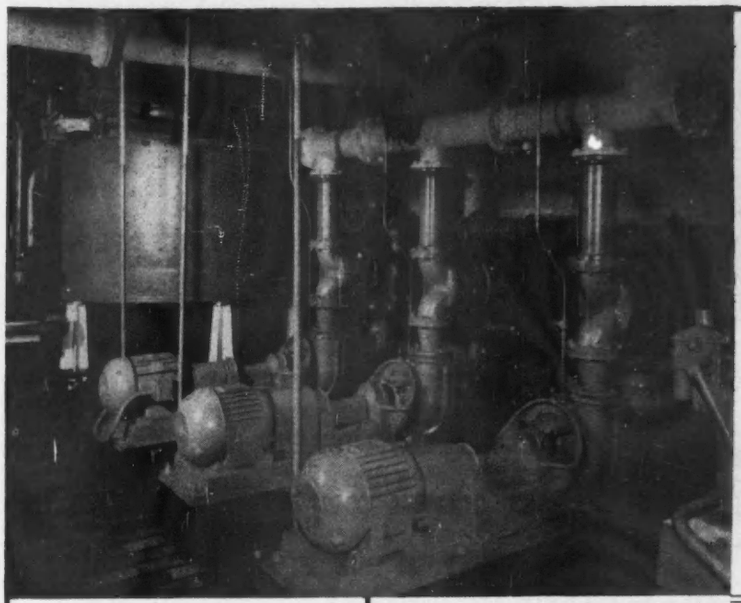


. . . let Mitchell handle your acid pumping problems

Enquiries invited for MITCHELL PUMPS for such duties as:

Zinc Leach for batch and continuous galvanising processes

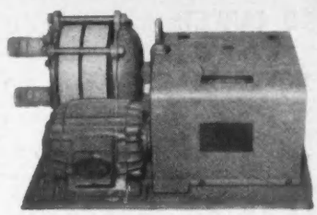
Sulphuric Acid and contaminated wash waters on pickling tanks and continuous pickling plants

Chromic Acid and Nickel Solutions for electrolytic plating plants including pumping to filters, etc

Waste pickle liquor and acidic effluents for neutralisation prior to disposal

Pumping of demineralised water

(Top left) Large battery centrifugal acid pumps
(Bottom left) Close-up view of diaphragm pump similar to the hand operated unit but arranged for motor drive
(Bottom centre) Hand operated portable diaphragm pump for emptying carboys or tanks and for general duties.
(Bottom right) Portable rotary displacement pump pumping plating solutions in the motor car trade



MITCHELL PUMPS give complete freedom from metal contamination of the liquids

SPECIALISTS IN ACID PUMPS

THE MITCHELL ORGANISATION

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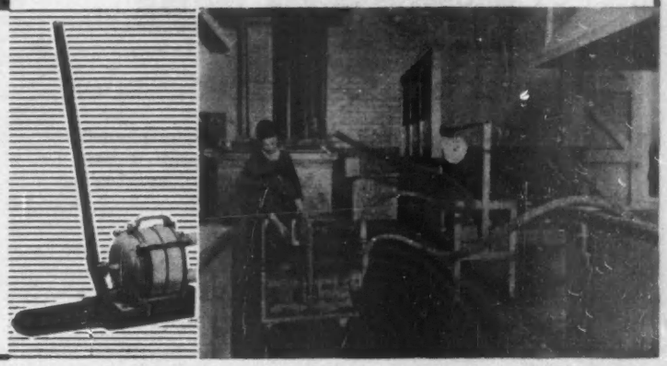

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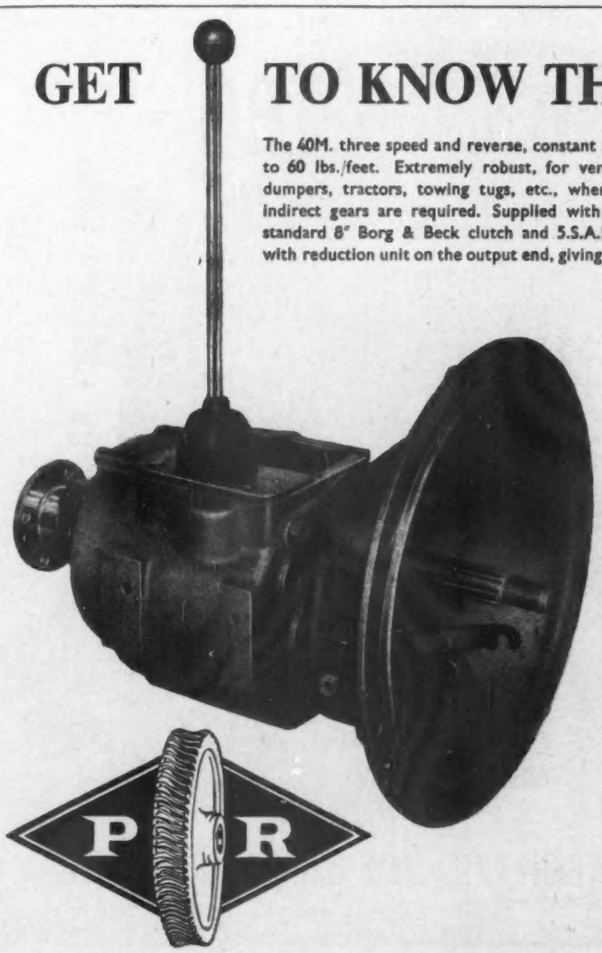
The 40M. three speed and reverse, constant mesh unit is capable of accepting up to 60 lbs./feet. Extremely robust, for very arduous conditions; suitable for dumpers, tractors, towing tugs, etc., where long periods of running in the indirect gears are required. Supplied with or without bell-housing to suit a standard 8" Borg & Beck clutch and S.S.A.E. engine mounting. Also supplied with reduction unit on the output end, giving an additional reduction of up to 3:1.



Have you seen our standard MOTOR IN WHEEL which gives a reduction of up to 30:1 in a single compact unit?

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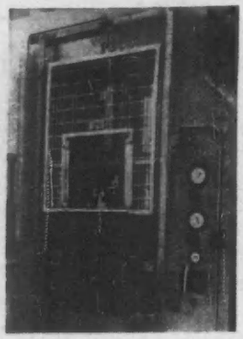
The illustration shows an interlock guard in use on a hydraulic press producing engine components.

For further information please write for leaflet No. 28.



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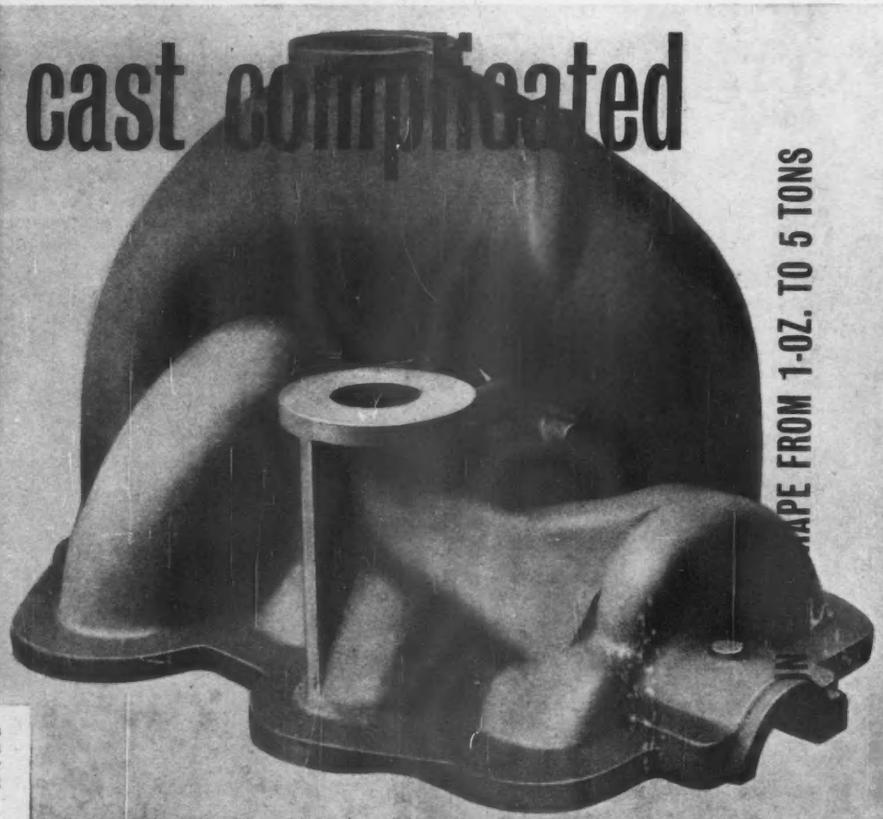
It's true, the Egyptians were casting in bronze before we were. Shiphams only started in 1798. But since then we've been using all the known bronzes; and have developed a skill, technique and service unsurpassed in this country, both as regards casting *and* pattern making.—Simple or complicated, casting enquiries should start at Shiphams.

Large illustration shows a Shipham casting for a Centrifugal Pump Cover —overall length 4' 0"; weight 1330 lbs. Alongside—Centrifugal Pump Body — overall length 4'0"; weight 2425 lbs.

cast complicated



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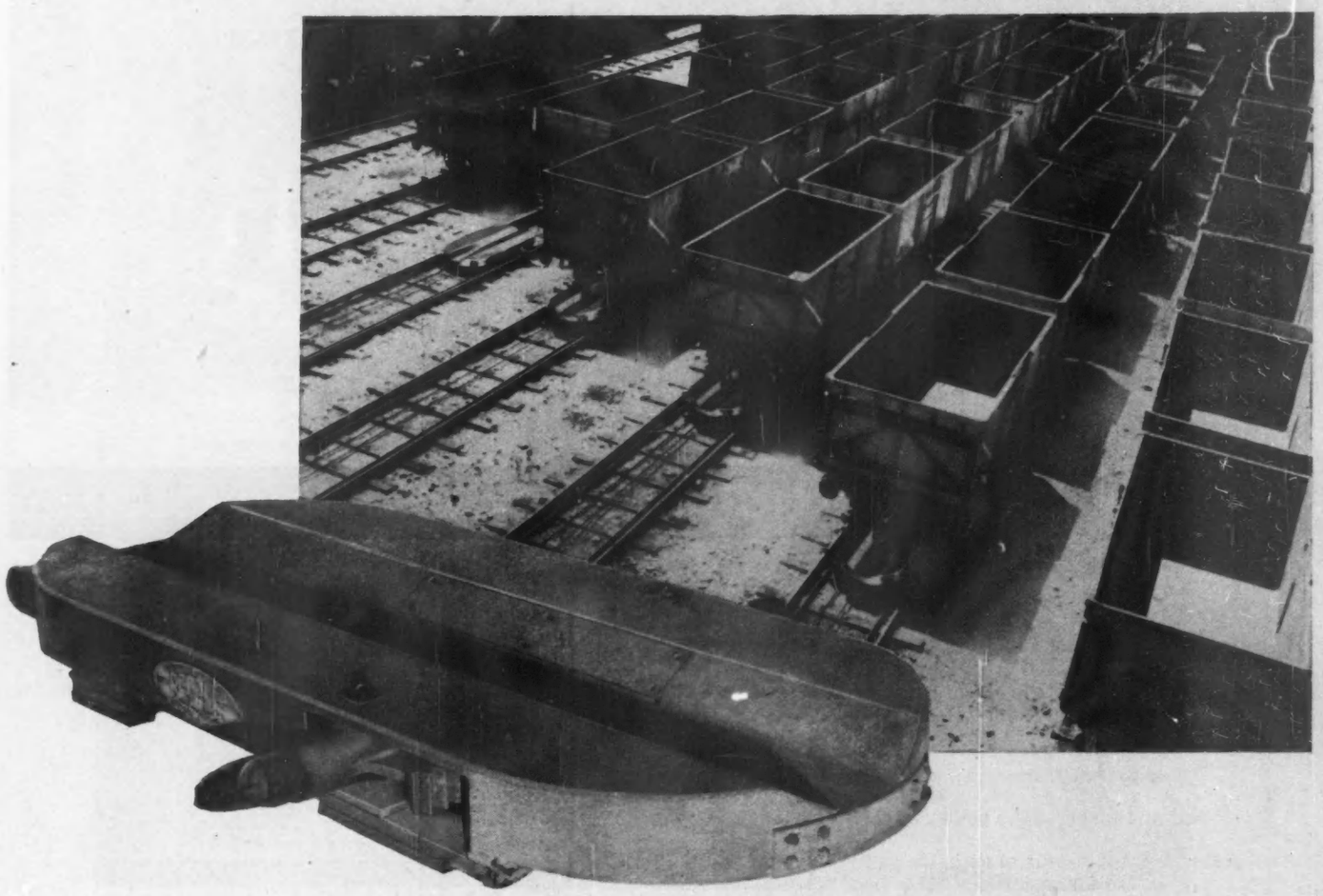
Hundreds of BEETLES are operating in Great Britain and overseas, handling railway stock selectively, safely—no loose ropes, no operatives in dangerous positions on the track—and with great saving of time and labour.



the BEETLE for wagon movement

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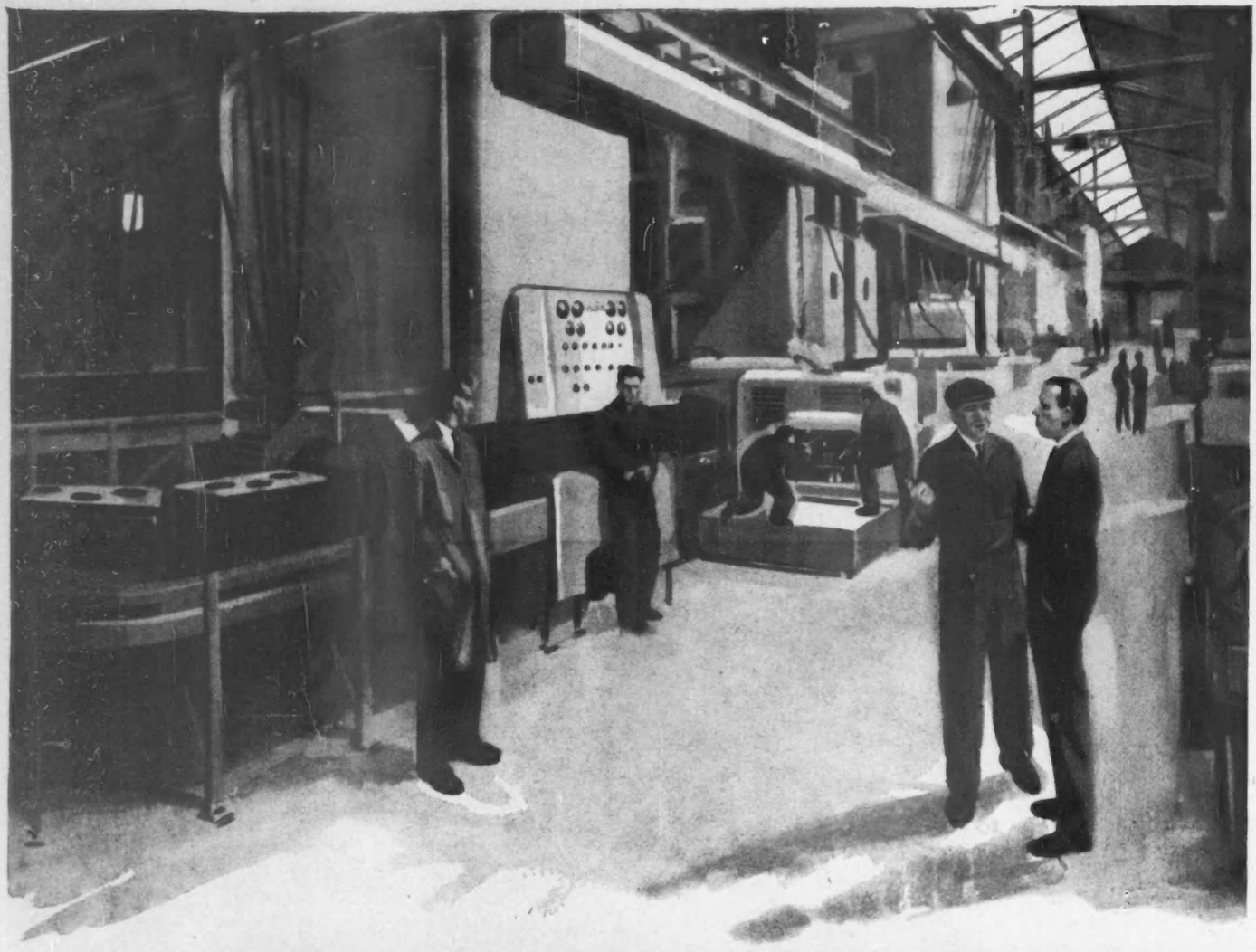

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. . . and ordinary lubricants have failed—Rocol Molybdenised Lubricants are the answer. Plating tough, wear resistant molybdenum disulphide—the most advanced lubricant known to engineering science—on to all bearing surfaces. Rocol Molybdenum Disulphide stays in action in conditions of high pressure, or extremes of temperature, up to 100,000 lbs. p.s.i. and 1000°F. On installations that are inaccessible and difficult, perhaps dangerous to get at, Rocol Molybdenised Lubricants substantially lengthen the period between essential maintenance operations.

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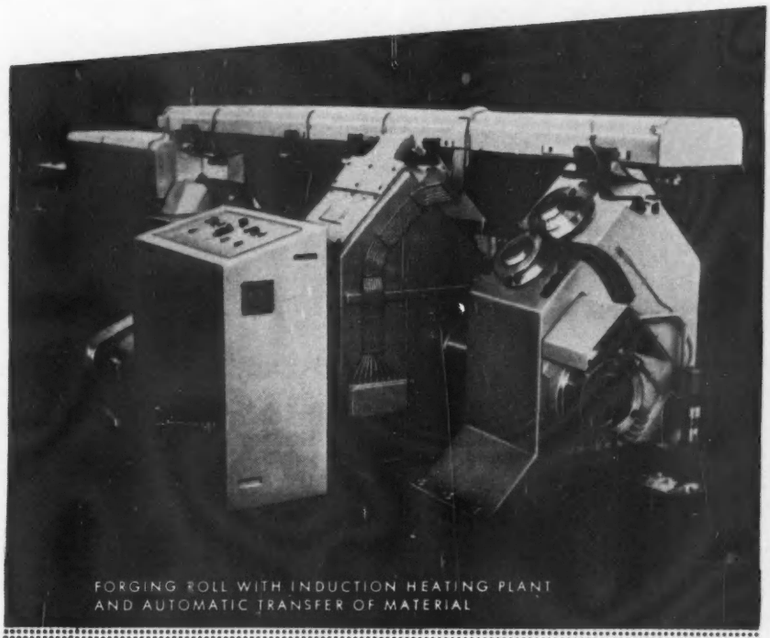

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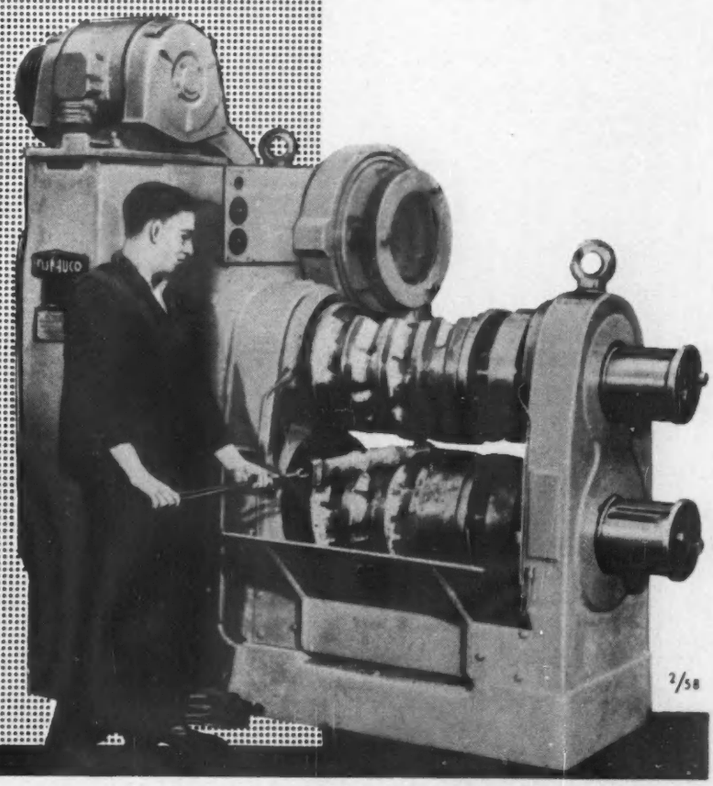

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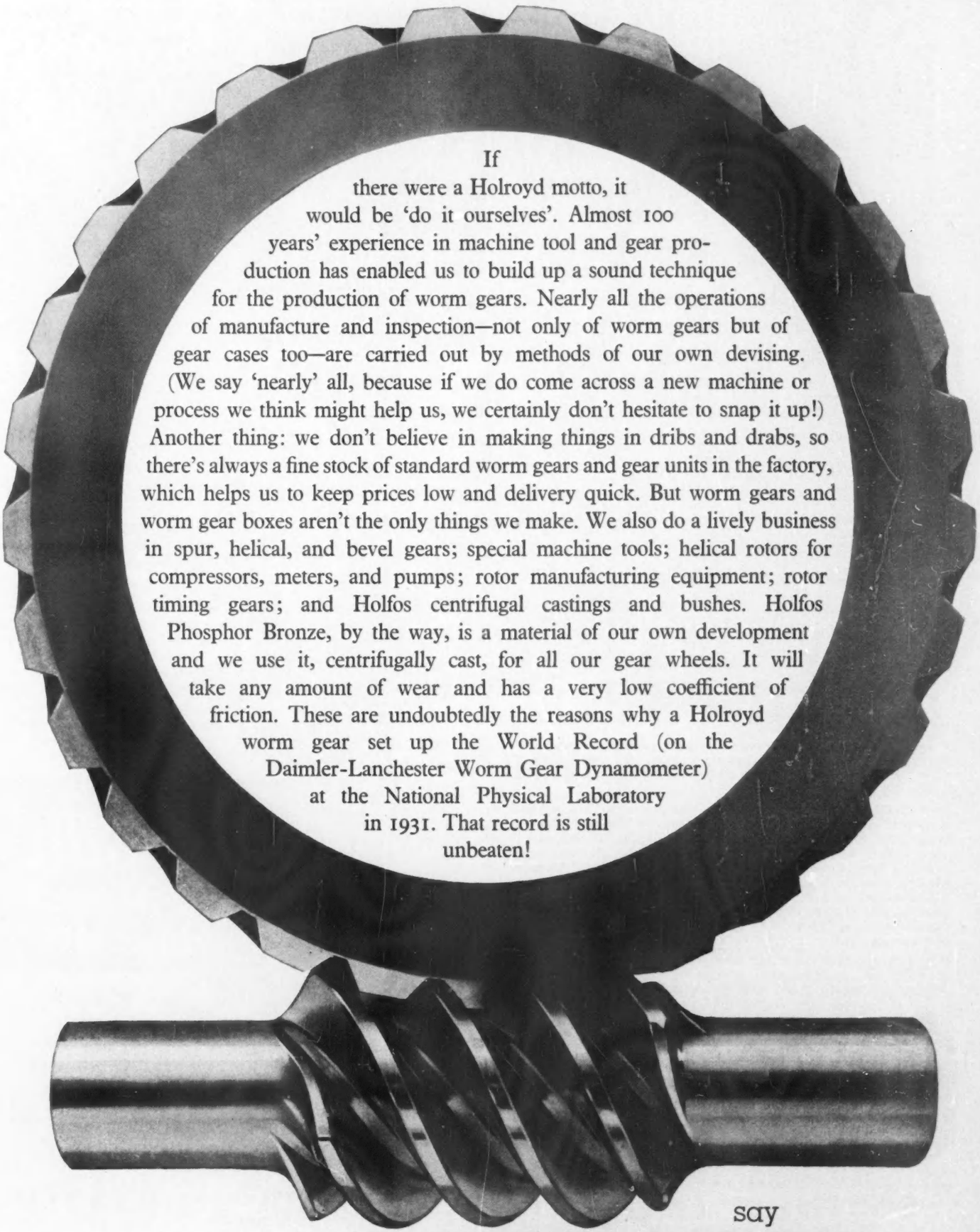

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would be 'do it ourselves'. Almost 100
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of manufacture and inspection—not only of worm gears but of
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Another thing: we don't believe in making things in dribs and drabs, so
there's always a fine stock of standard worm gears and gear units in the factory,
which helps us to keep prices low and delivery quick. But worm gears and
worm gear boxes aren't the only things we make. We also do a lively business
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friction. These are undoubtedly the reasons why a Holroyd
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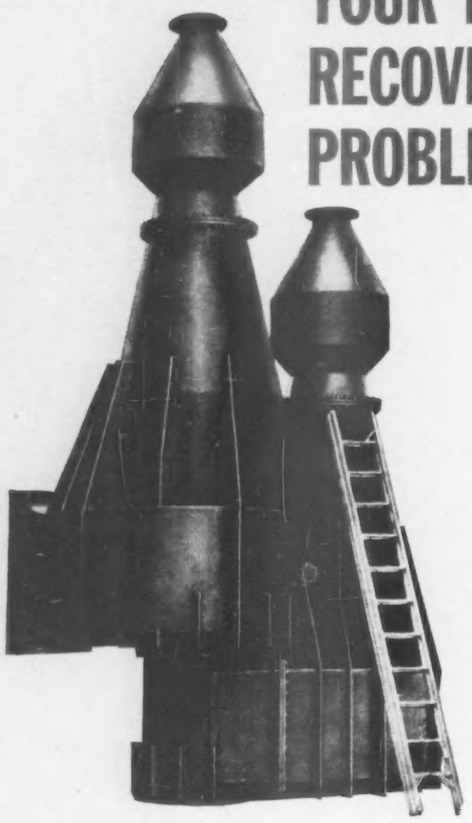

A wide variety of industries in Britain are constantly being presented with acute dust recovery problems and it is particularly apt therefore that Ambuco Ltd. should open up in London at this time.

Over 1,300 dust recovery installations engineered by Ambuco and its parent company are in use all over the world. Now they are available in Britain and the Sterling Area. Ambuco cyclones will not plug even with loadings of up to one pound of dust (7,000 grains) per cubic foot of gas. They can be made of a number of different materials and can be completely lined against the effects of heat, corrosion or abrasion. In many industries Ambuco systems are used to recover *valuable* dusts, in fact, in these cases it has been found that *eight out of every ten installations pay for themselves within a few years.*

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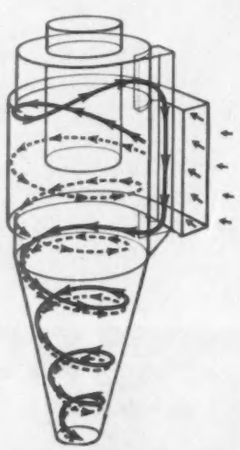
The Ambuco Cyclone is unique in that it contains a "shave-off" port. Dust whirling upward in the "double-eddy" current is caught and removed. In ordinary cyclones much of this dust would be re-entrained, thus reducing efficiency.



AMBUCO

Experts at engineering Extra Efficiency in DUST COLLECTION SYSTEMS

A SUBSIDIARY OF BUELL ENGINEERING, INC., U.S.A.

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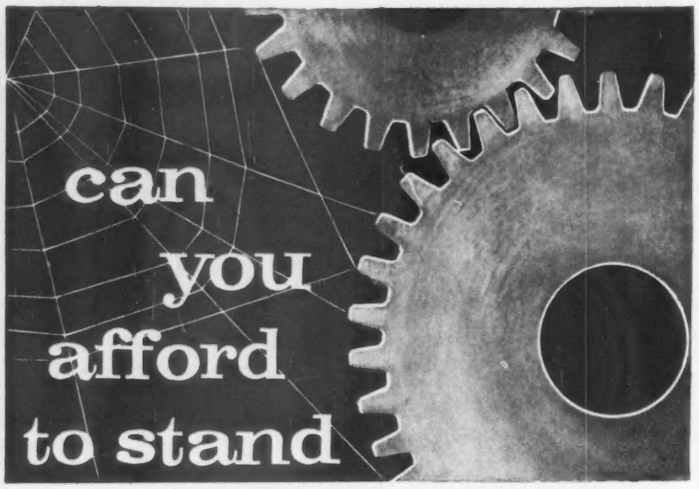

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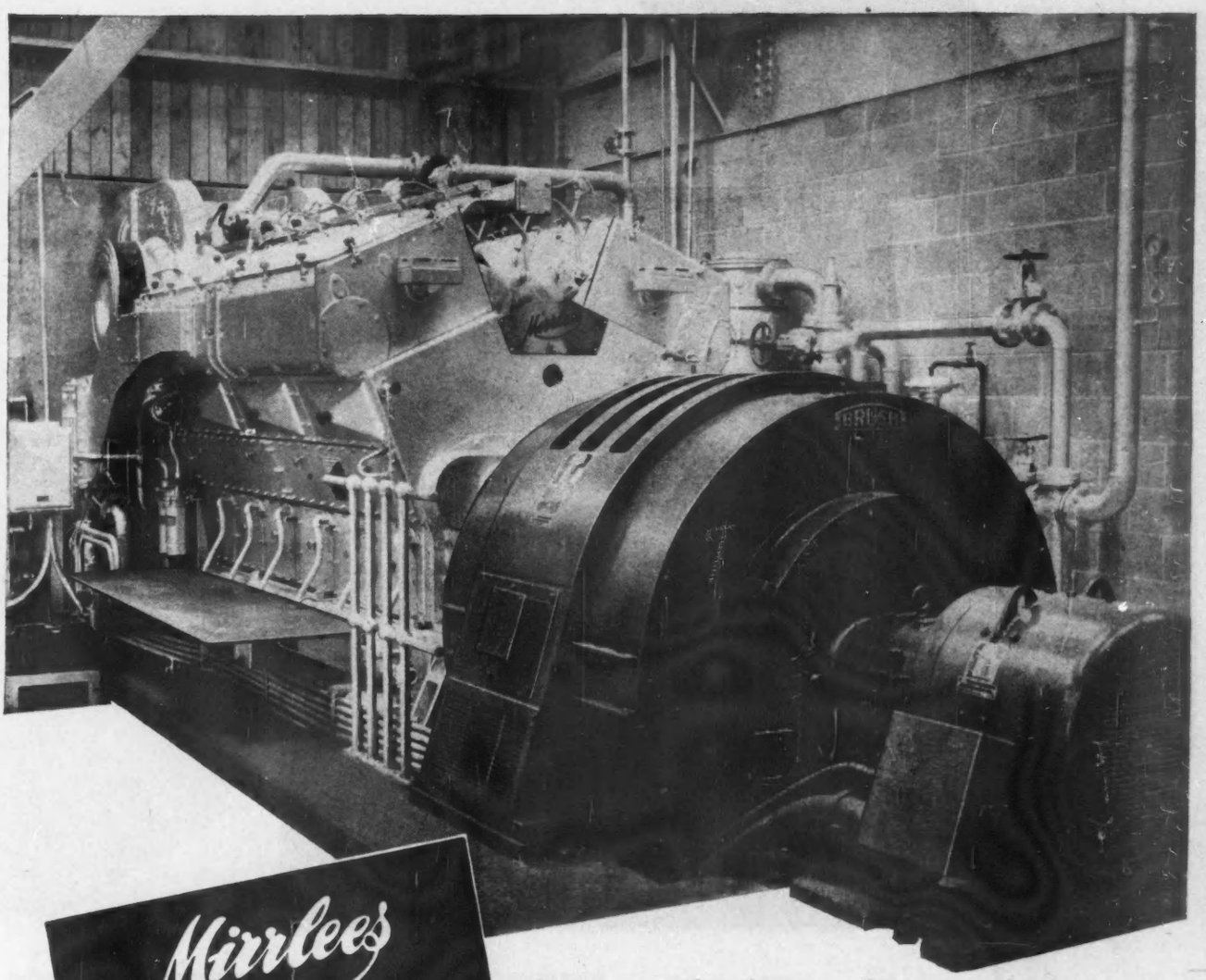

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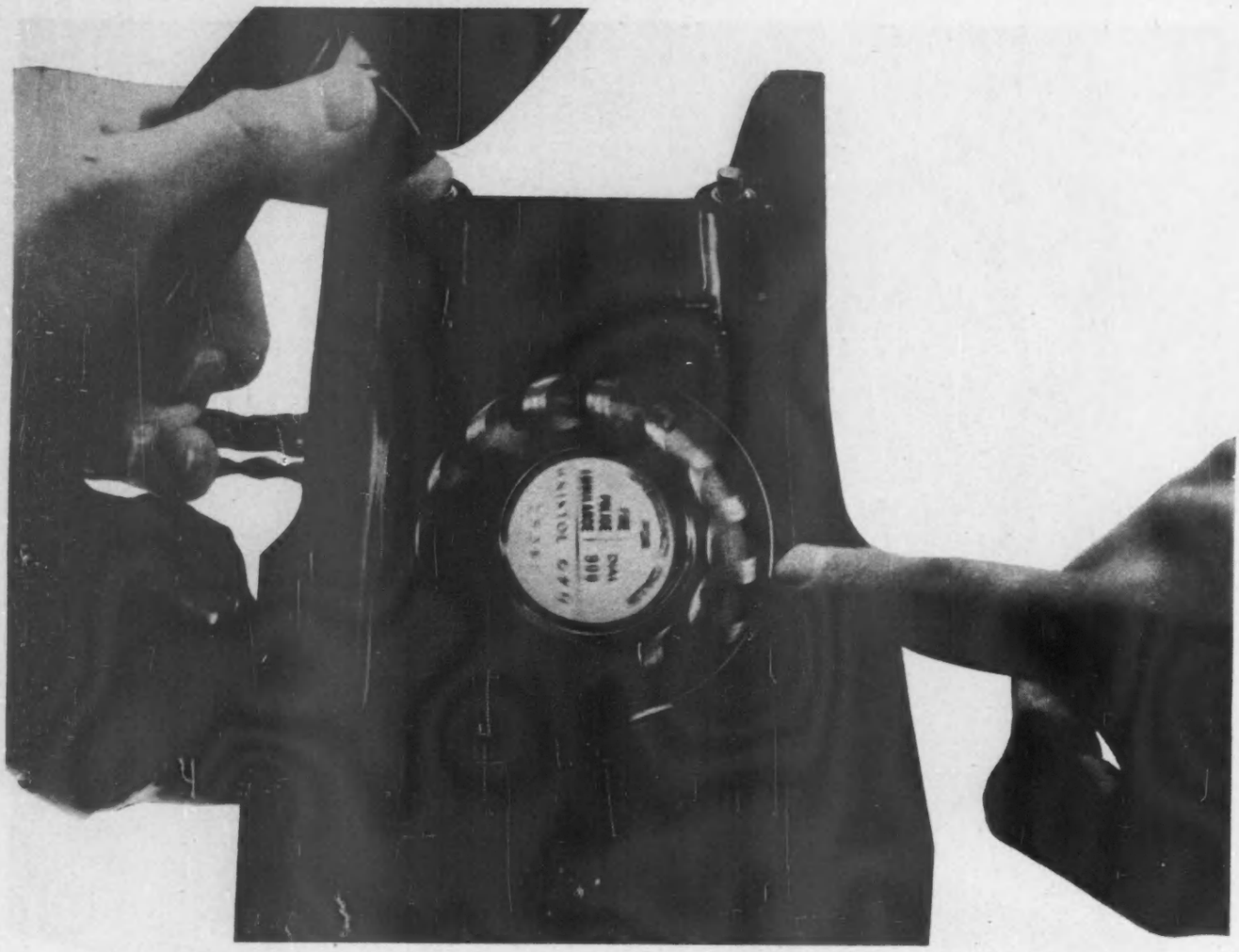
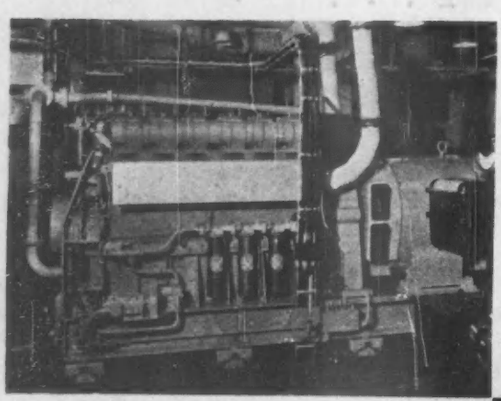


the choice is 'automatic'



One of the Paxman automatic mains failure sets installed at the Bristol G.P.O. Telephone Exchange, and supplied through Austinlite Ltd.

A Paxman standby diesel generating set was chosen to safeguard power supply for round-the-clock operation of the Subscriber Trunk Dialling System at the Bristol Central Telephone Exchange.

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the essential standby power for industry and public services

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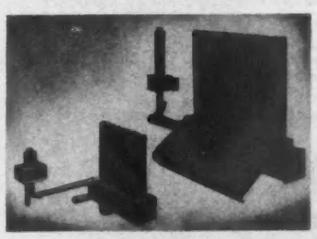

This design is simple and robust. It is NOT a spray which causes damage to hot refractories. There are NO jets to get blocked. Its internal operation is indicated by the external Tell-Tale.

Photograph of two sizes Water Screen for incorporation into Refuse Destructor Schemes.

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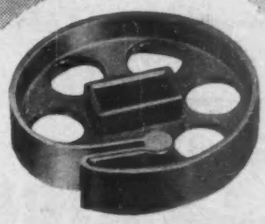

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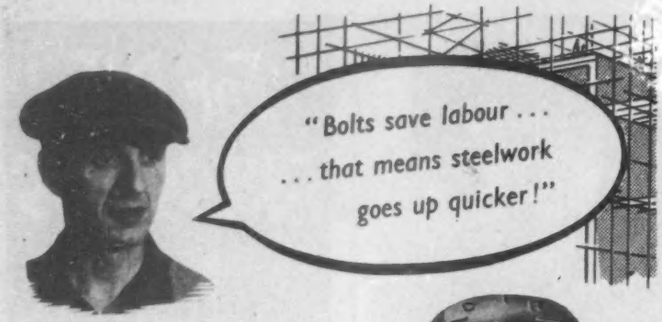
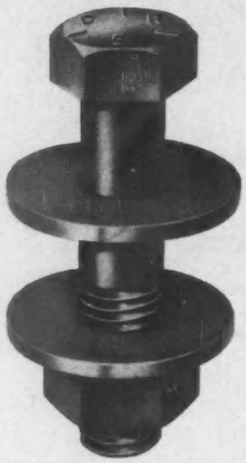


Economy of labour—that's the really big saving possible when you use Richards High Strength Friction Grip Bolts. A two man team only is required for bolting against four men when riveting. And there is no heating required, no noise and simplified erection methods are possible. Surely very sound reasons why you should . . .



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RICHARDS

high strength friction grip bolts

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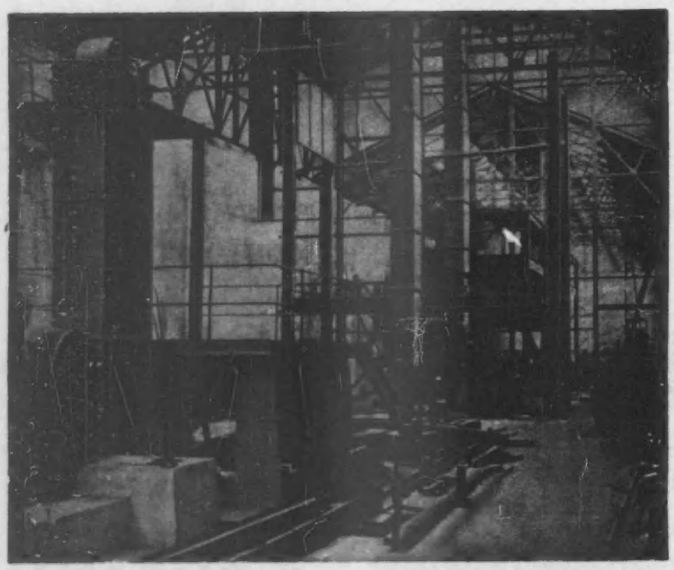

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The 'KARISCOL' system of prefabricated steel-framed building is suitable for a wide range of purposes, and is used throughout the World for :-

BUS DEPOTS	**FACTORIES**	**WAREHOUSES**	**ASSEMBLY SHOPS**
MACHINE SHOPS	**GARAGES**	**SOCIAL HALLS**	**BARRACKS**
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and for many other purposes by
ROAD AND RAIL TRANSPORT AUTHORITIES, MUNICIPALITIES, NATIONALISED INDUSTRIES AND GOVERNMENT DEPARTMENTS

Interior of two-bay KARISCOL building for J. R. Bramah & Co. Ltd., Sheffield.

Architects: Hadfield, Cawkwell & Davidson.
Main Contractors: J. F. Finnegan & Co. (Sheffield) Ltd.

Kariscol
Prefabricated Steel-framed
BUILDINGS
score on all points

●COST
The use of standardised interchangeable units saves up to 20% in steel, and up to 50% in erection time compared with conventional steelwork.

●SPEED
The prefabricated steelwork for single or multiple-bay 'KARISCOL' buildings can normally be erected *in a matter of days* on a previously prepared site.

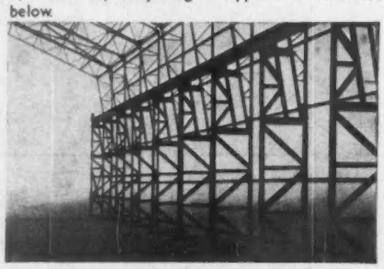
●FOUNDATIONS
Foundation requirements are reduced to a minimum (only two holding-down bolts to each unit).

●LABOUR
'KARISCOL' Buildings require no on-site riveting or welding, and can be erected by unskilled labour.

●SIZE
30ft. and 40ft. clear span.
(12ft. or 15ft. to eaves)
50ft. and 60ft. clear span.
(15ft. or 20ft. to eaves)
75ft. and 100ft. clear span.
(17ft. 6in. or 20ft. to eaves)
Extendible to any length in increments of 12ft. 6in. in single or multiple bays.

'KARISCOL' and CRANES

KARISCOL buildings can be supplied with gantries for electric or hand-operated cranes up to 5 tons, by means of specially designed supports as illustrated below.



PERMANENT or TEMPORARY

The patented KARISCOL system provides close approximation to conventional permanent structures, but the absence of riveting or welding permits easy dismantling with a consequent high recovery value.

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Telephone: OAKENGATES 120. Telegrams: LILLESHALL, OAKENGATES.
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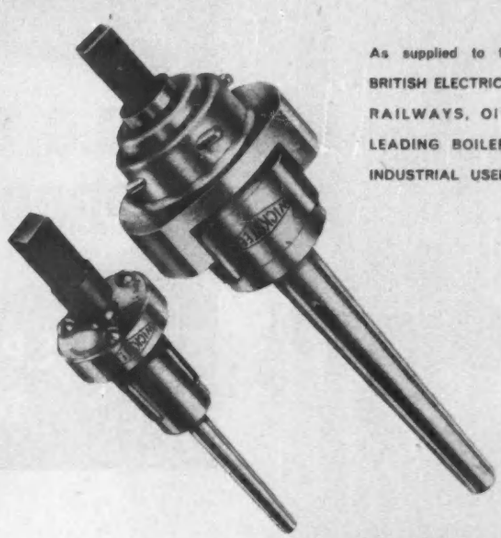
The Wicksteed Automatic Torque Control Unit. Designed for use with a conventional drill type electric Motor accurately produces uniformly pressure tight tube joints. When the preset torque limit is reached the motor automatically reverses. Standard Units are for 100/120 or 210/240 volts A.C., with voltage variation compensation. Using Wicksteed adjustable ball bearing thrust type Expanders, tubes ⅜" to 1" and under certain conditions smaller and larger tubes can be accommodated. Write for further details.



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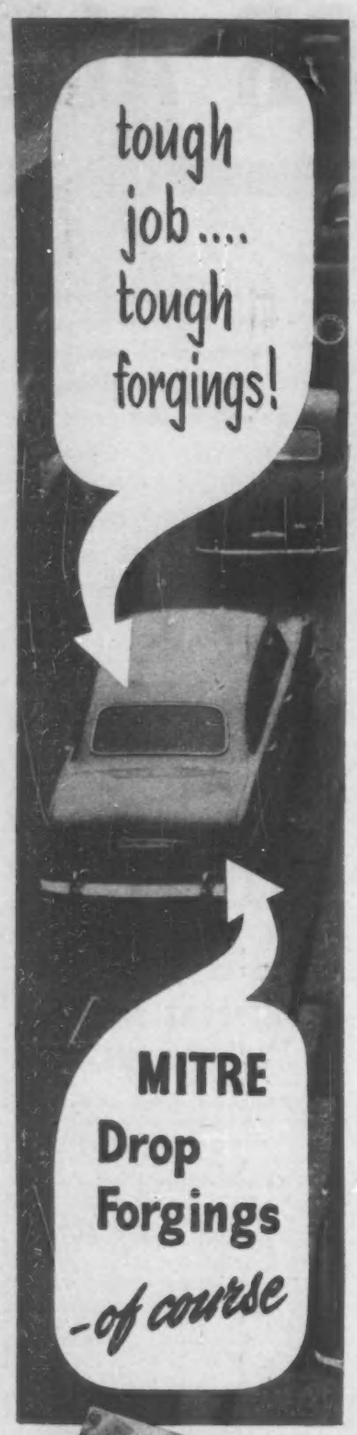

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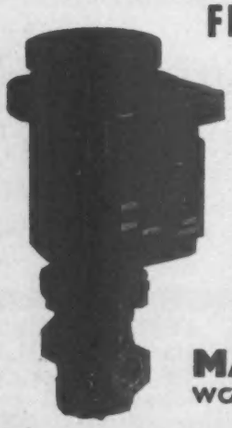

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Bores ¼" to 4"	0–1500	do

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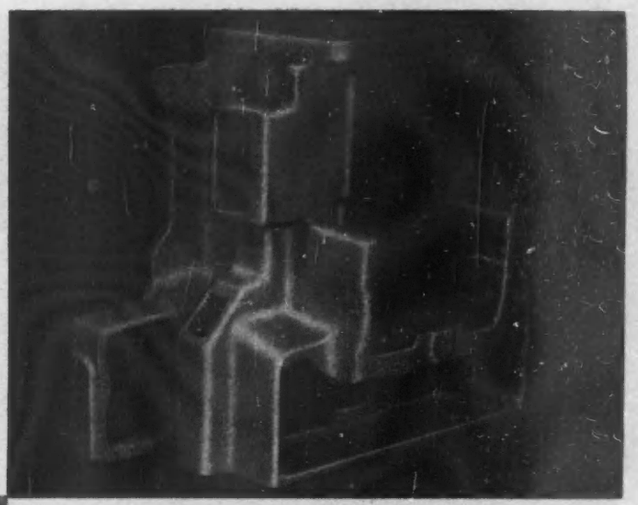

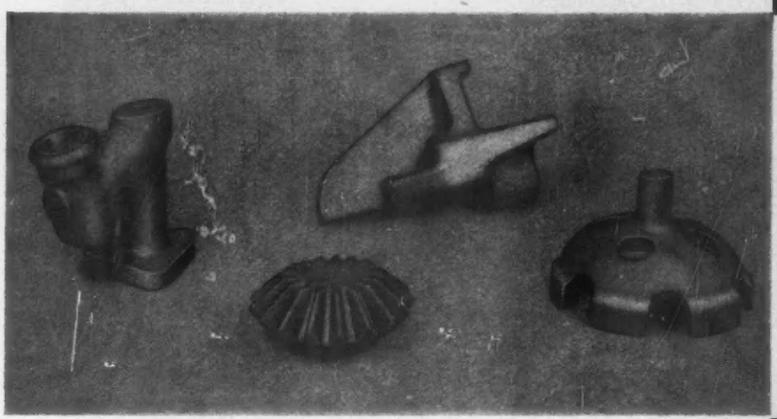

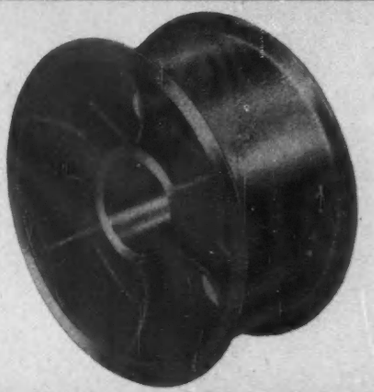

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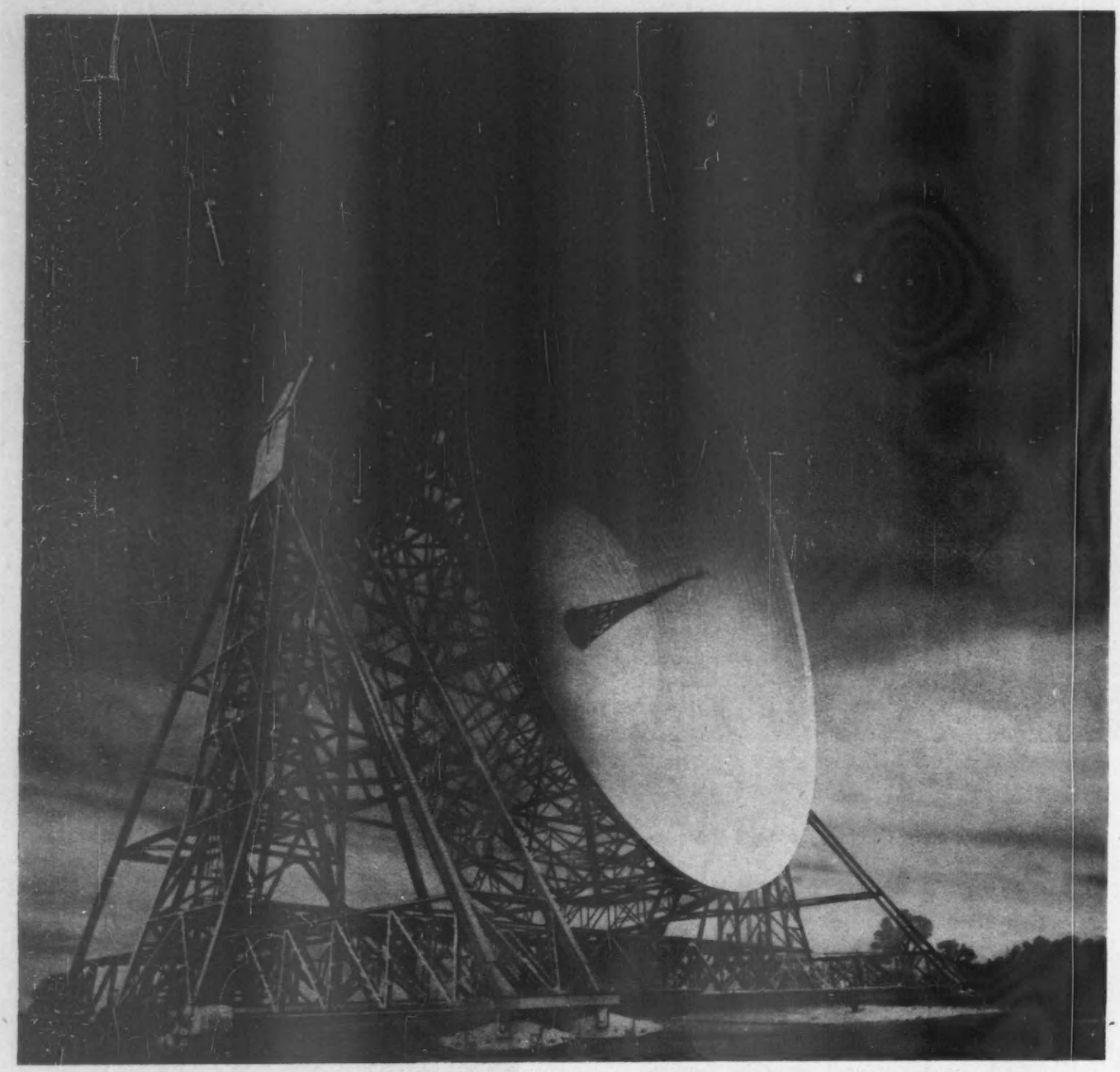

Acknowledgments to Husband & Co., Consulting Engineers, and to The United Steel Companies Ltd.

Reaching for the stars . . .

Mankind has for ever been reaching for the stars, and today space travel is fast being transformed from a dream into a practical reality. The great radio telescope at Jodrell Bank, which provides a vital link between the earth and space satellites, is making an all important contribution to man's knowledge of the universe. This vast steel structure is the largest steerable radio telescope in the world and it represents one of Britain's finest engineering achievements. It was designed and constructed by British engineers and the bowl was exclusively welded with Murex "Fastex 5" and "Ironex 5" electrodes, while the trunnions were welded with Murex "Fortrex 35" electrodes. These electrodes are at your service.

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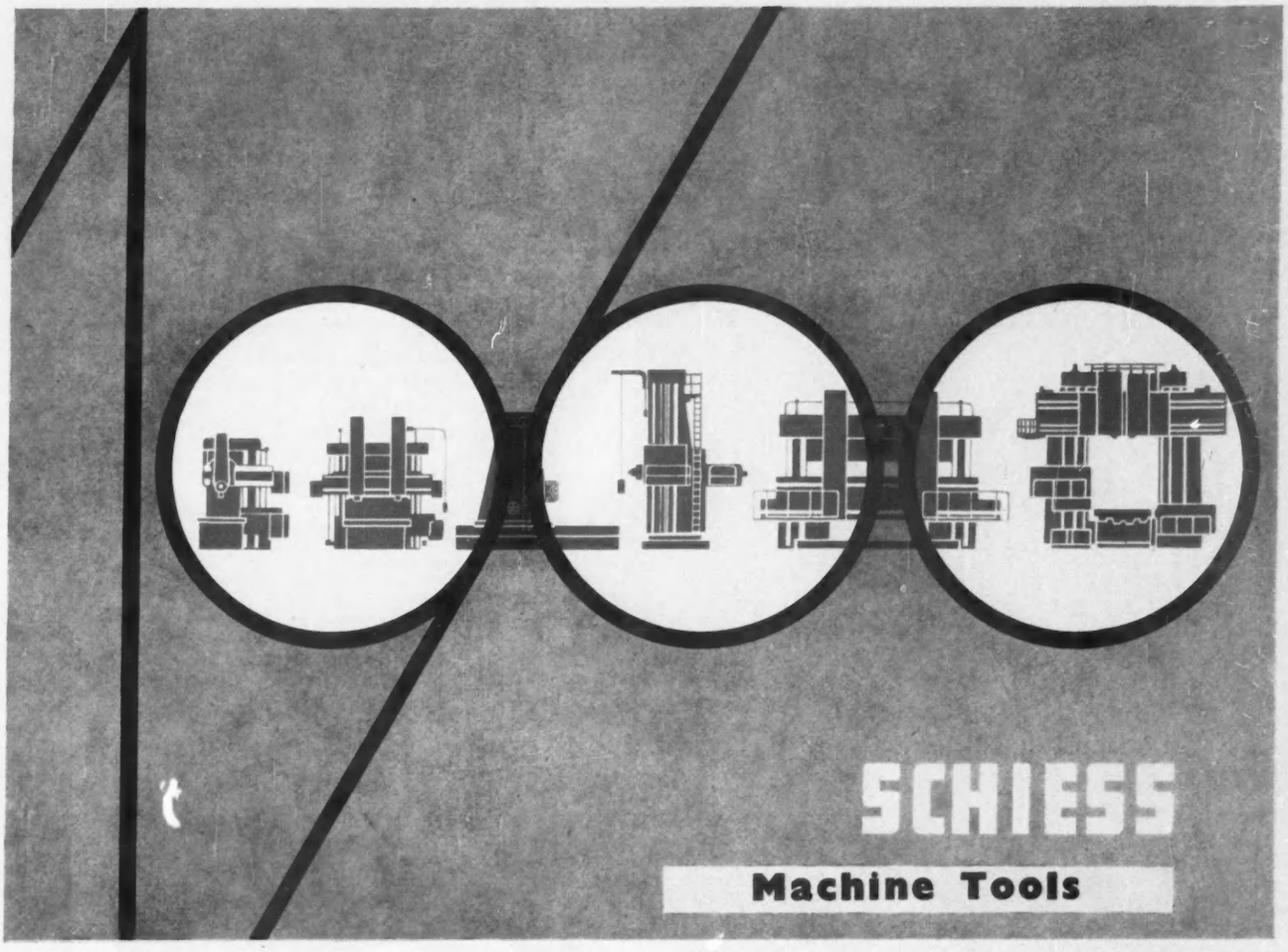

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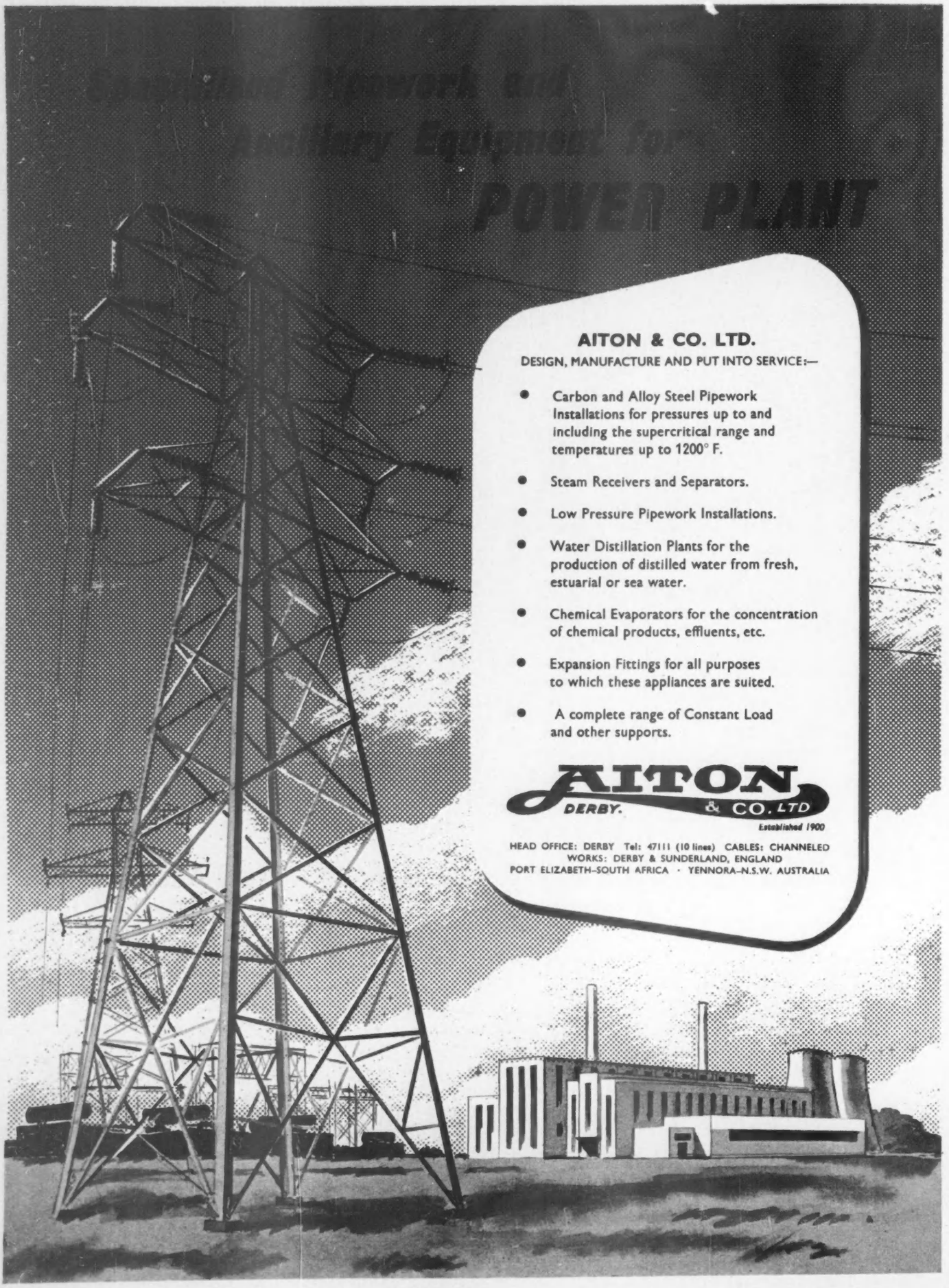

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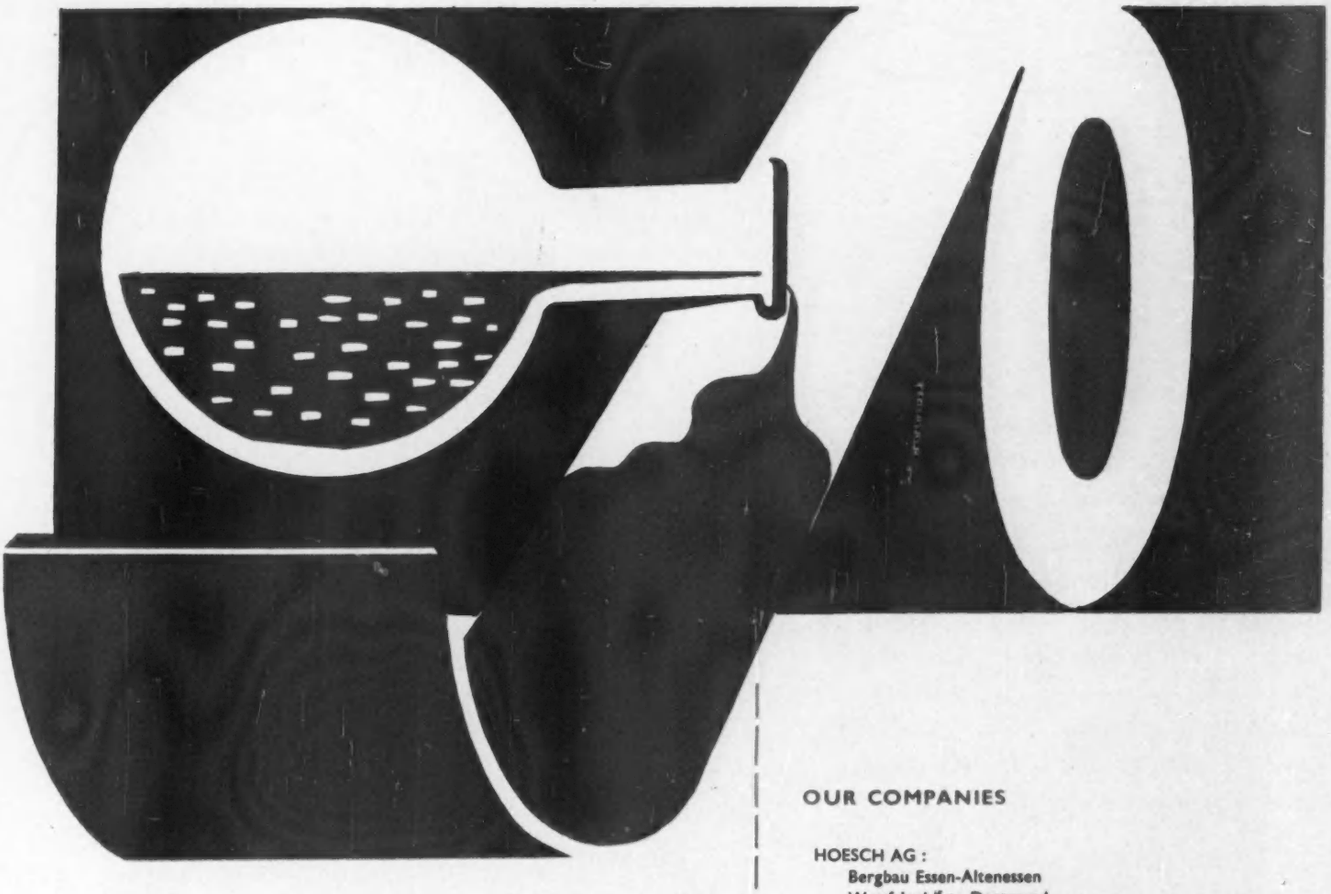

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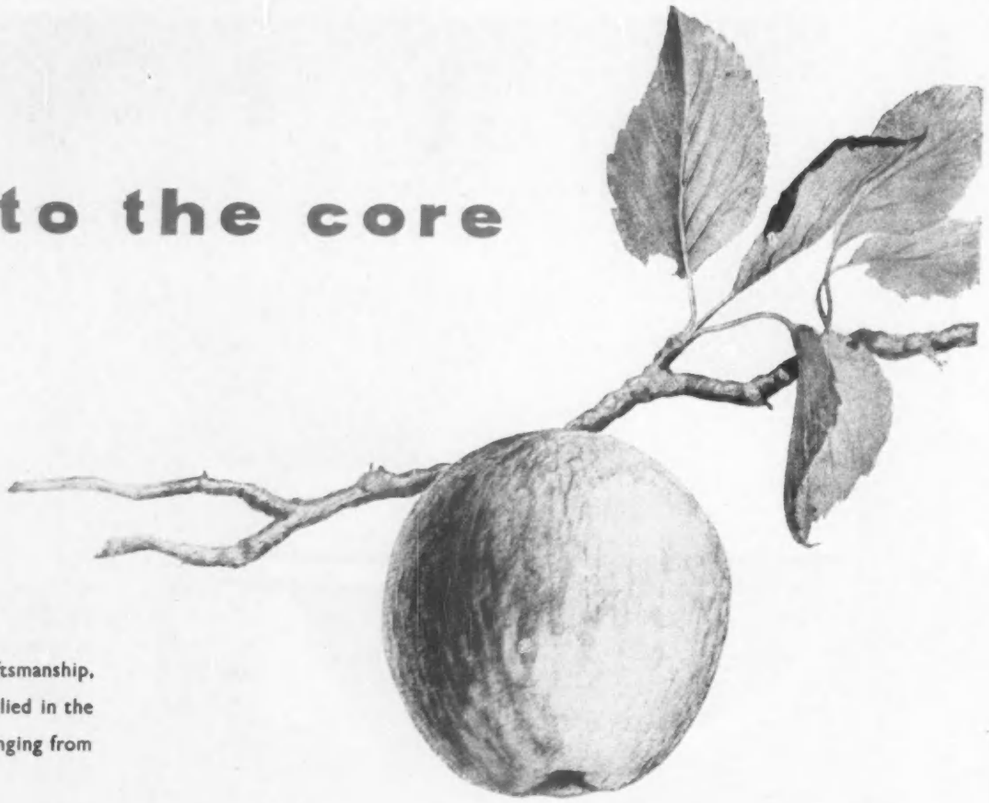
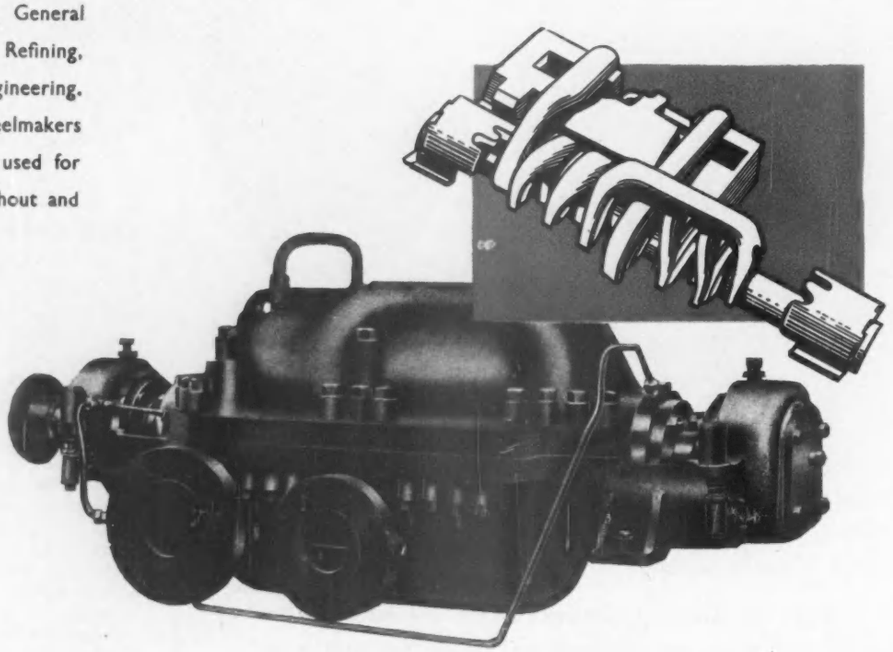
Sound to the core



Modern steel-founding is a blend of craftsmanship, art and technology, all of which are applied in the Osborn foundries to produce castings ranging from a few pounds to several tons in weight.

Castings in carbon and alloy steels are manufactured for many industries including General Engineering, Mining, Quarrying, Oil Refining, Dredging, Chemical and Electrical Engineering. The Company's reputation as steelmakers ensures that only the finest steels are used for these castings, which are sound throughout and of the ultimate standard of quality.



Osborn castings are used in this *Hayward Tyler - Byron Jackson six stage 'Multiplex' pump.* Inset illustrates core used for casting the upper half of casing.

OSBORN

FINE STEELMAKERS · STEELFOUNDERS · ENGINEER'S TOOLMAKERS

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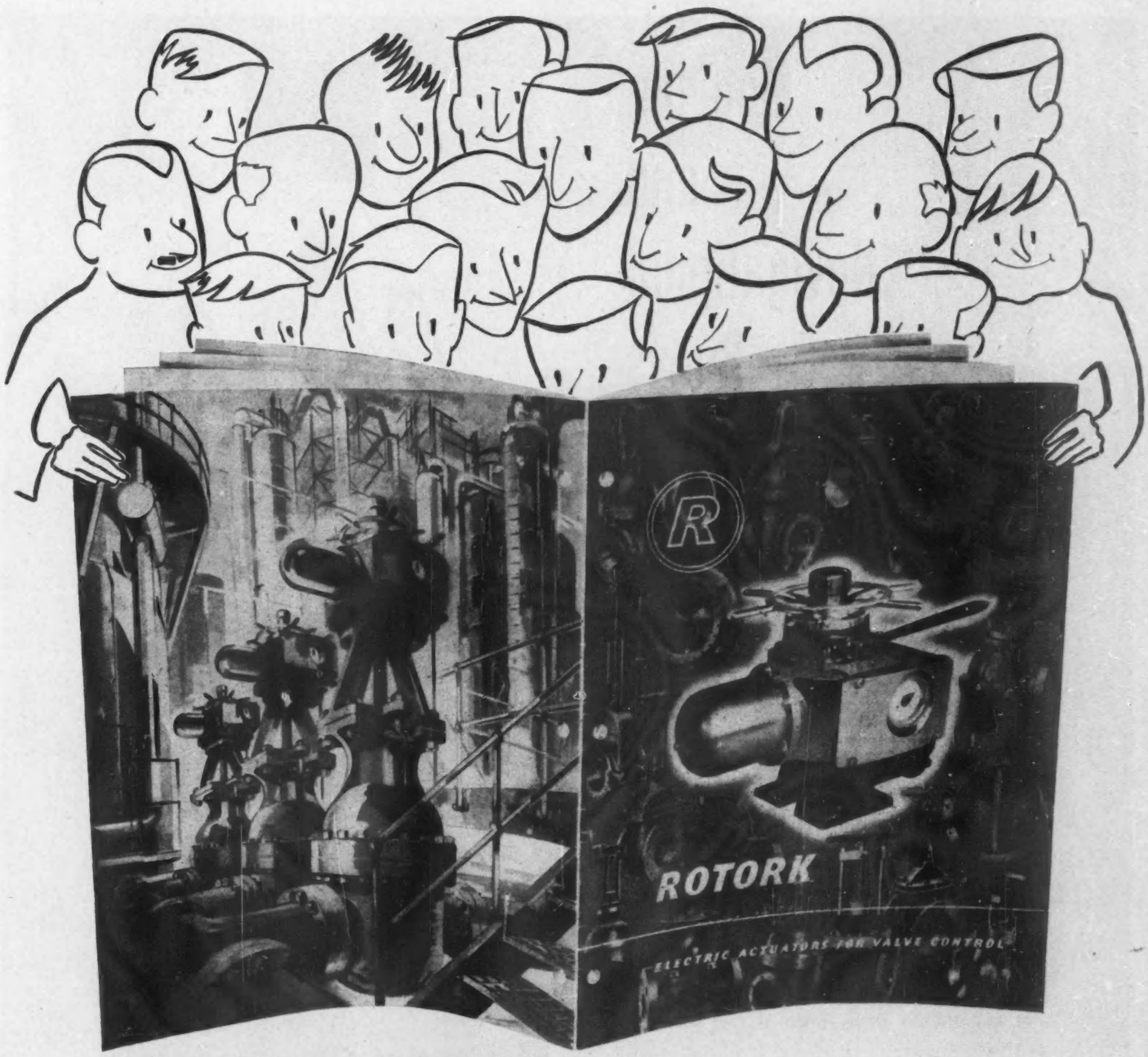

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All you engineers responsible for pipework installations know that the motorisation of valves is not a new practice. But (and this is really important to you) it assumes *revolutionary proportions* when the associated electrical and control equipment is developed to provide a flexible, versatile system that enables all sizes and types of valves (and thereby related plant) to be operated in a manner which exposes hand control as hampering, inefficient, uneconomic, human-error-prone and often hazardous.

Now this development is precisely what Rotork have accomplished; and you, on whom modernisation programmes and plant development depend, will surely want to be aware of the progress in valve motorisation.

The booklet is yours for the asking. It's packed with information and includes an impressive section on the uses to which Rotork actuators are put by Esso, Shell, B.P., Kuwait, Standard Vacuum, Harwell, Dounreay, Richard Thomas & Baldwin, Rolls Royce, C.E.G.B., I.C.I., and many others.

Rotork Actuators for Valve Control

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Mooring and Navigational Buoys

Buoys which mark the shipping channels leading to a Port or Harbour, buoys which mark hazards such as unseen rocks or wrecks — and mooring buoys, are manufactured at the Brown, Lenox Works at Millwall, London, E.14 on the River Thames.

The buoy illustrated is equipped with a day-mark, an occulting light, a bell for fog warnings, and a radar reflector. *It was made to the order of a well known company specialising in the provision of the light sources for navigational buoys.*

All types of buoys, mooring and navigational, are illustrated in the BROWN, LENOX "Moorings and Buoys" Booklet; *copies of which can be obtained from either of the addresses given below.*

An announcement by the Marine Division of

BROWN, LENOX & CO. LTD.

ASSOCIATED COMPANY: BROWN, LENOX & CO. (LONDON) LTD., MILLWALL, E.14

PONTYPRIDD · GLAMORGAN

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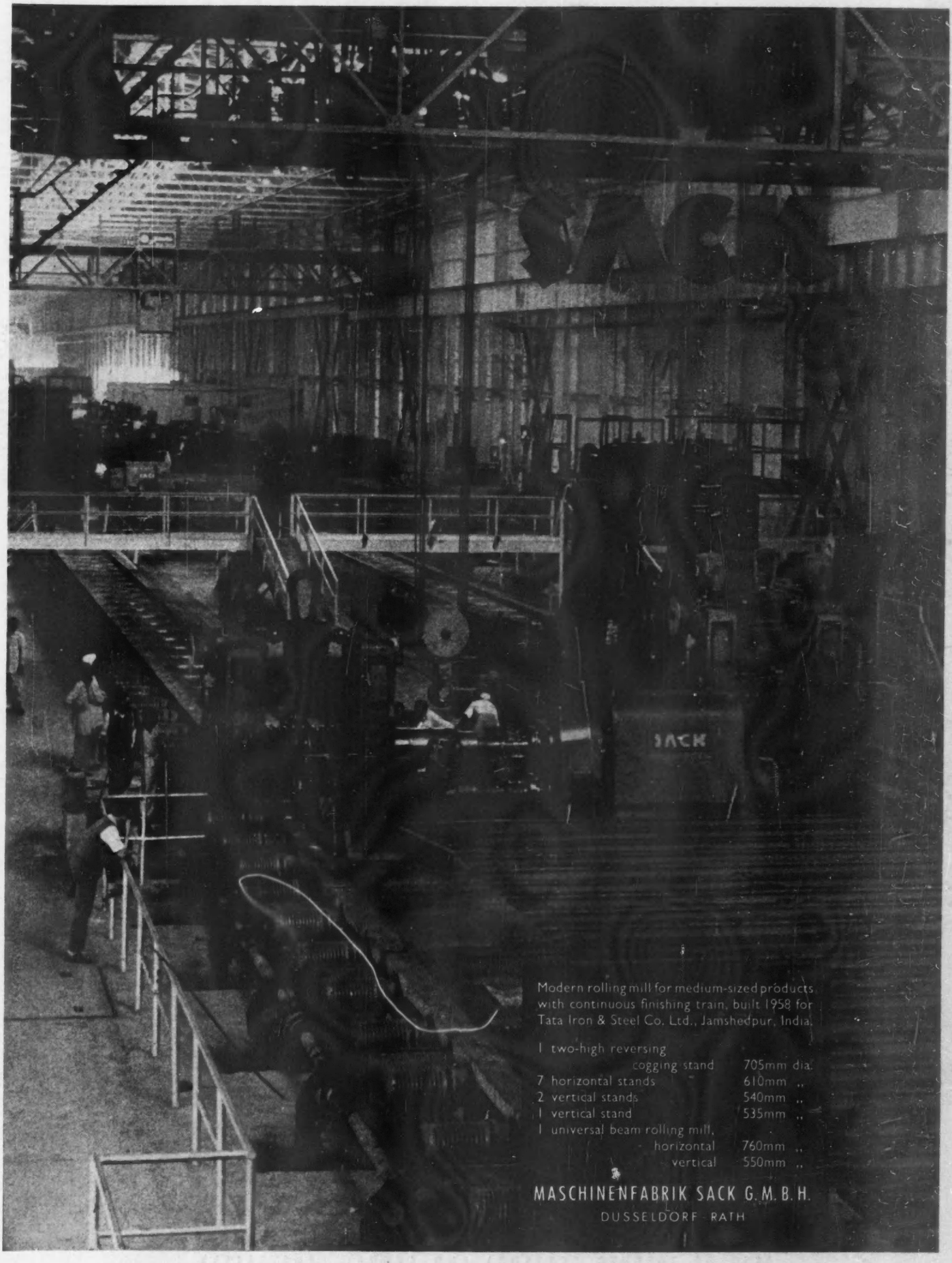

Modern rolling mill for medium-sized products with continuous finishing train, built 1958 for Tata Iron & Steel Co. Ltd., Jamshedpur, India.

1 two-high reversing cogging stand	705mm dia.
7 horizontal stands	610mm ,,
2 vertical stands	540mm ,,
1 vertical stand	535mm ,,
1 universal beam rolling mill, horizontal	760mm ,,
vertical	550mm ,,

MASCHINENFABRIK SACK G.M.B.H.
DUSSELDORF-RATH

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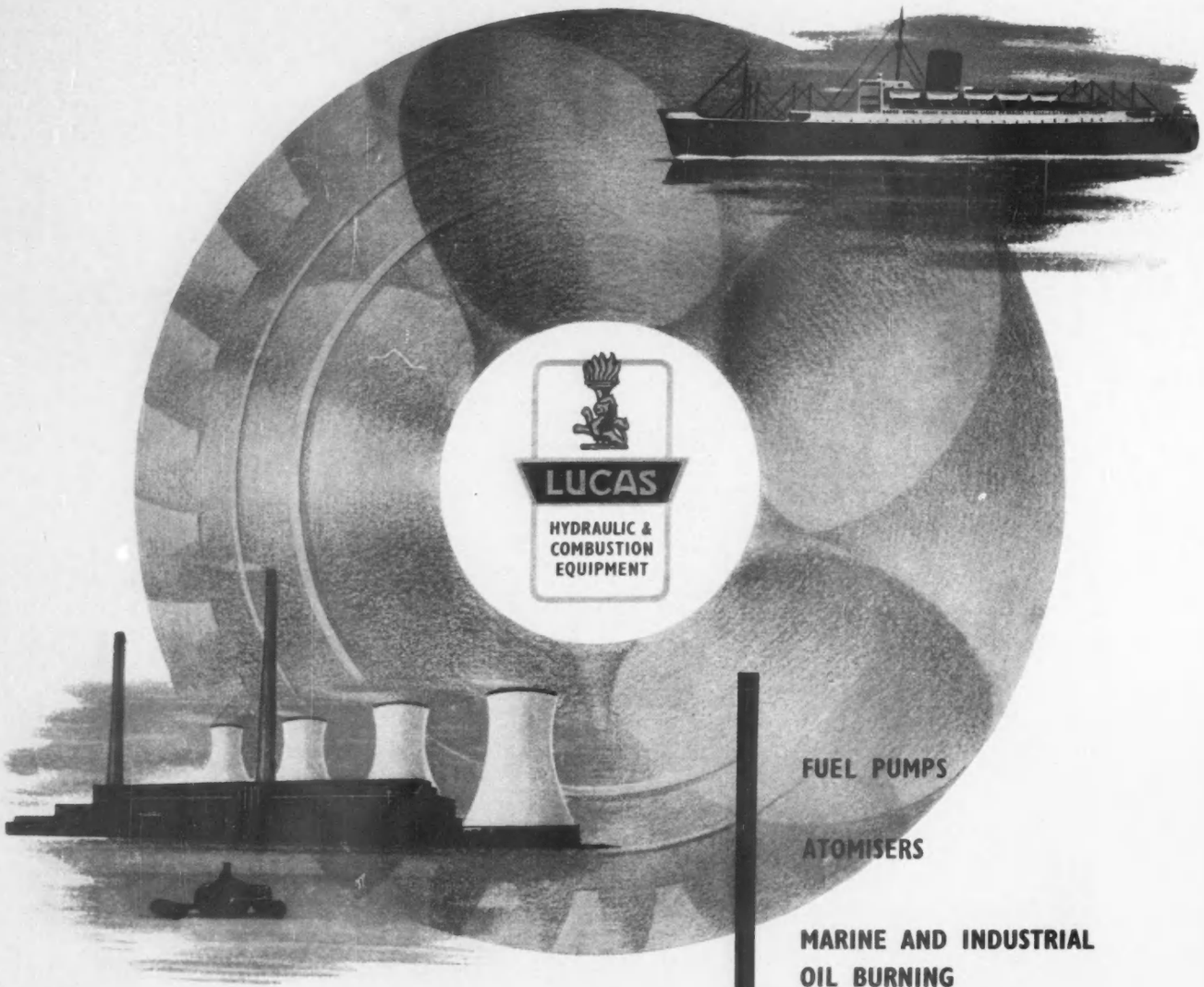
THE PRIME MOVER



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ATOMISERS

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JOSEPH LUCAS (HYDRAULIC & COMBUSTION EQUIPMENT) LTD · MARSTON GREEN · BIRMINGHAM · ENGLAND

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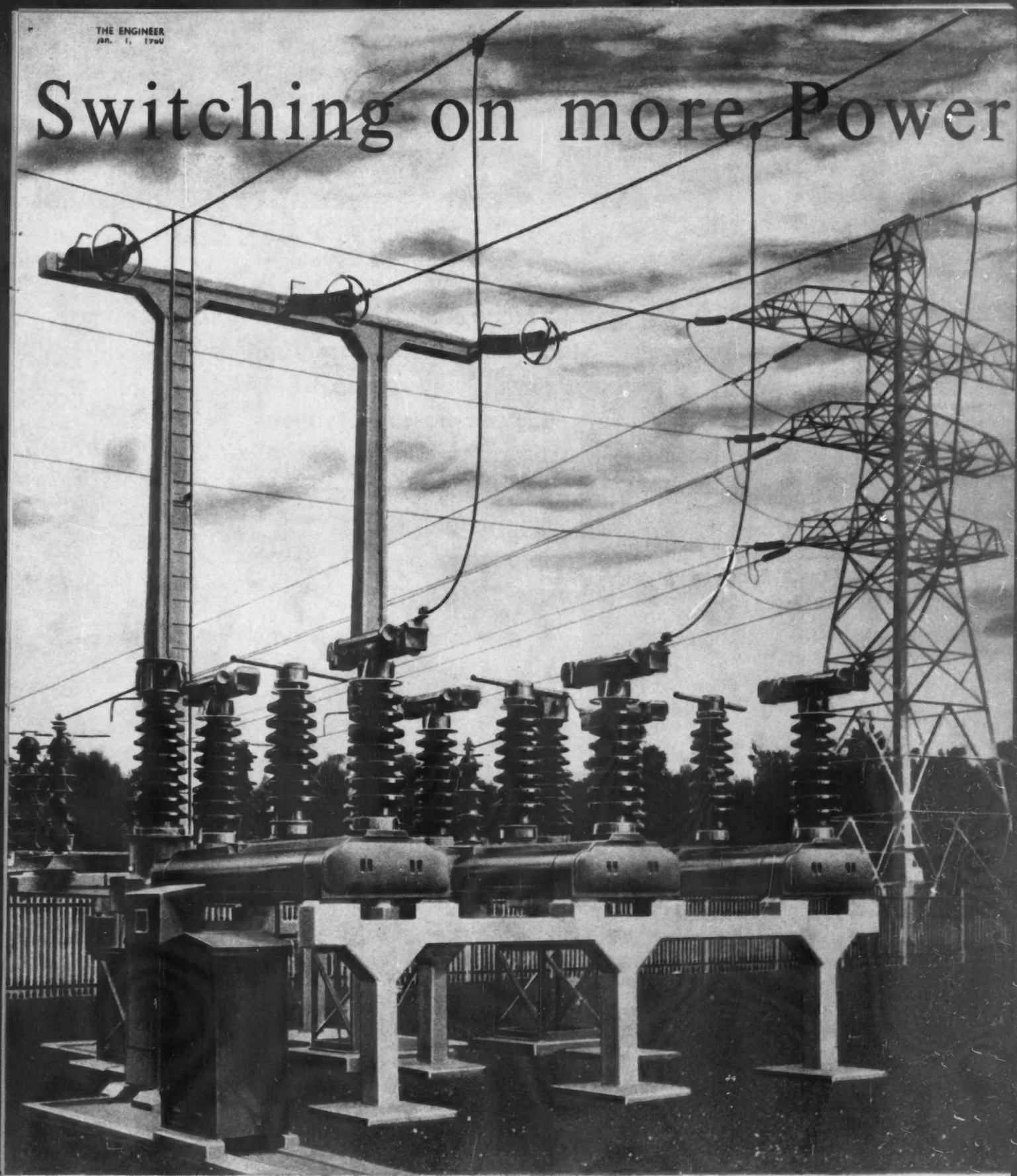

The photograph shows a 132 kV., 3,500 MVA., Type GA6W4 Air-Blast Circuit Breaker installed in a British substation

This type of breaker is in extensive use on the British grid system, and has been selected to control the output of Scotland's first Nuclear Power Station at Hunterston. Overseas, 132kV., 5000-MVA., Type GA6W4 breakers will be installed in seven new sub-stations in the Greater Buenos Aires area of Argentina.

Associated Electrical Industries Limited

SWITCHGEAR DIVISION

Trafford Park, Manchester · Higher Openshaw, Manchester · Willesden, London

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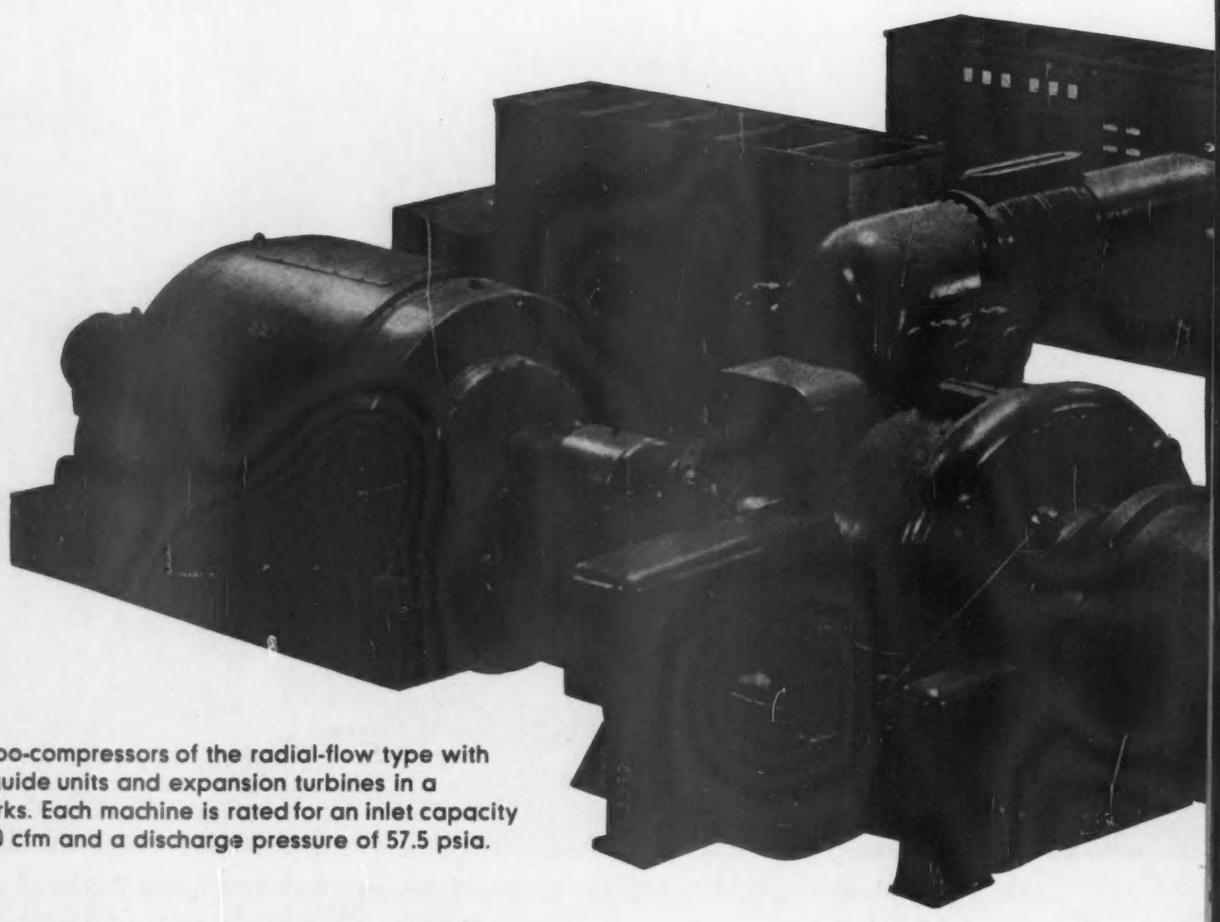
DEMAG Compressors for all

DEMAG's manufacturing range is comprehensive and varied and includes the most suitable compressors for any application - for any gas, any pressure and any delivery volume. DEMAG builds rotary and reciprocating compressors of various designs, turbo-compressors of the axial and radial flow-type as well as compound plants with turbo-compressors followed by reciprocating compressors.



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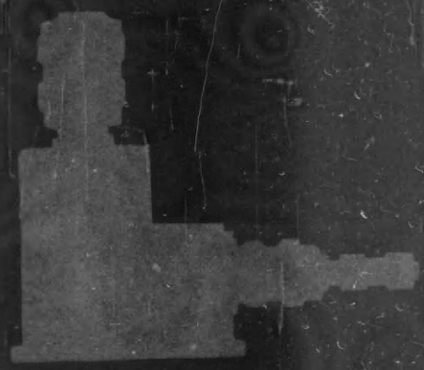

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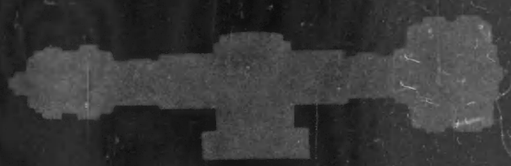

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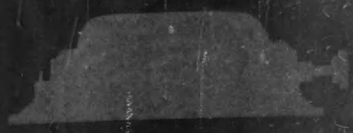

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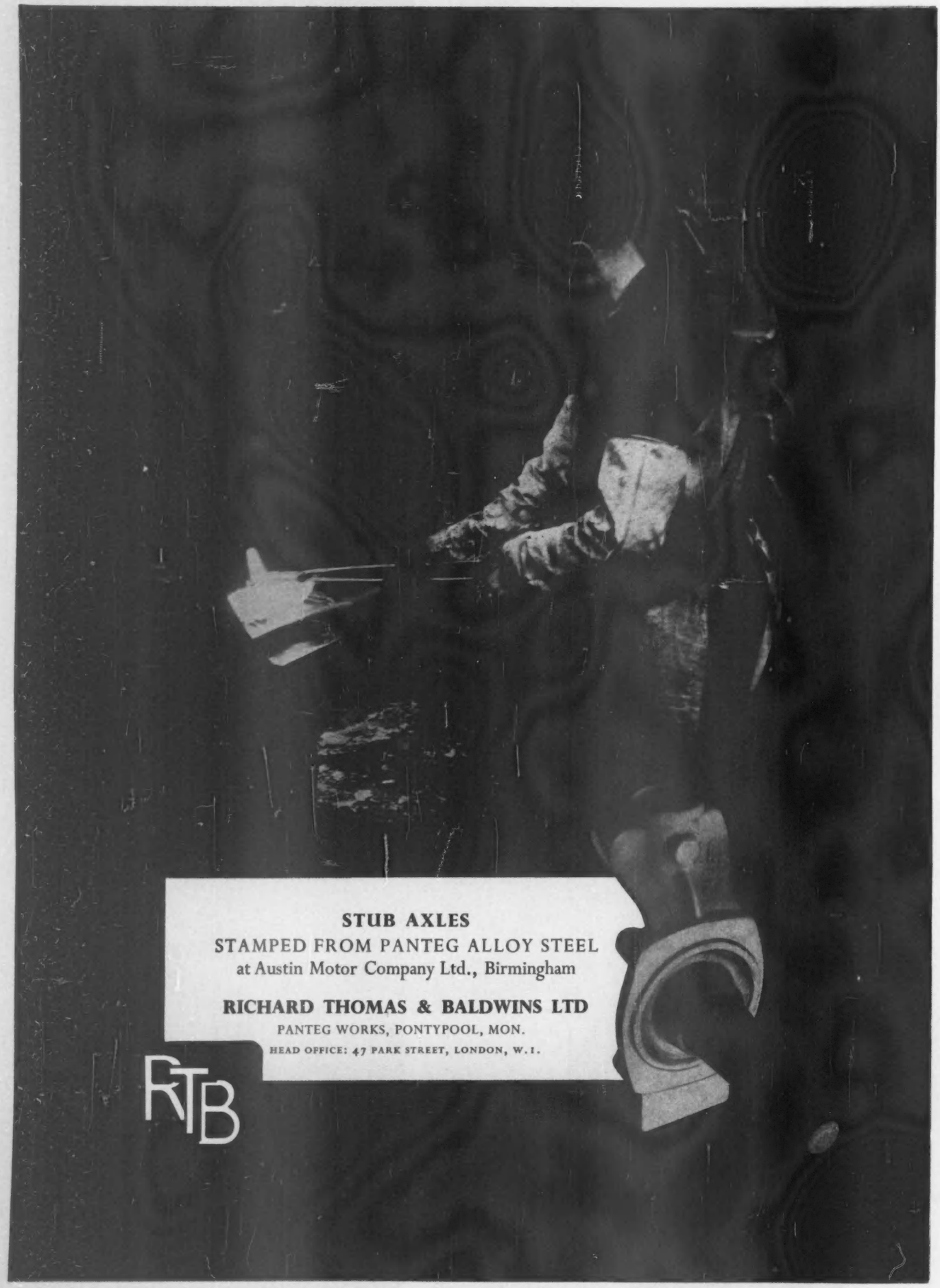
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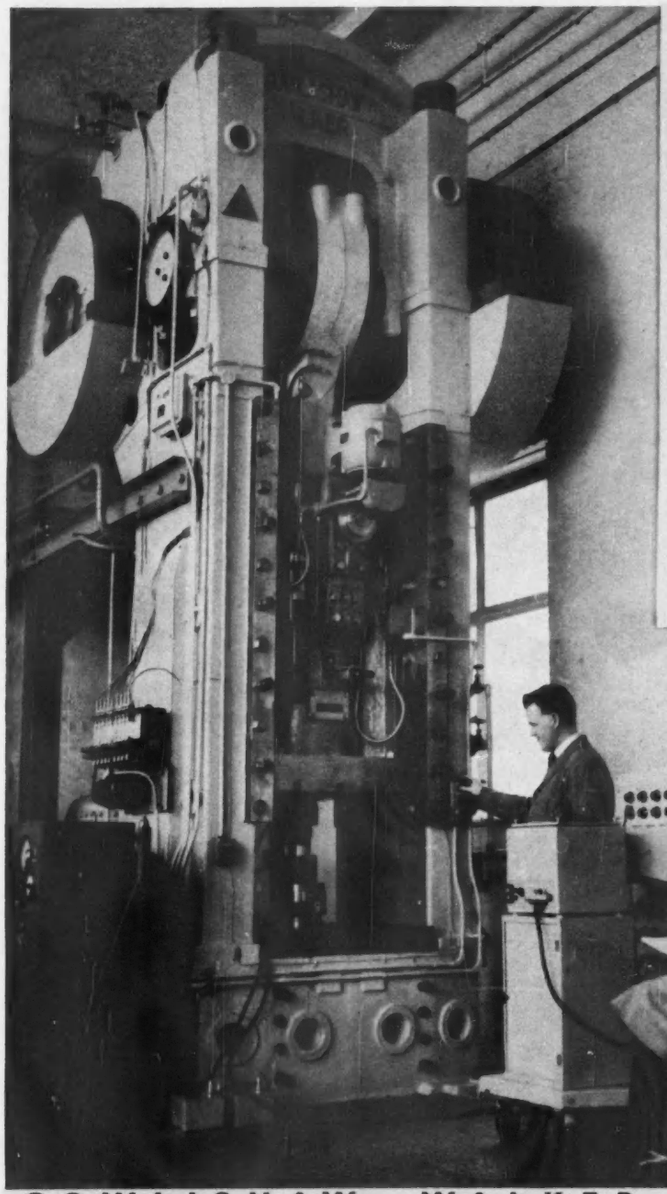

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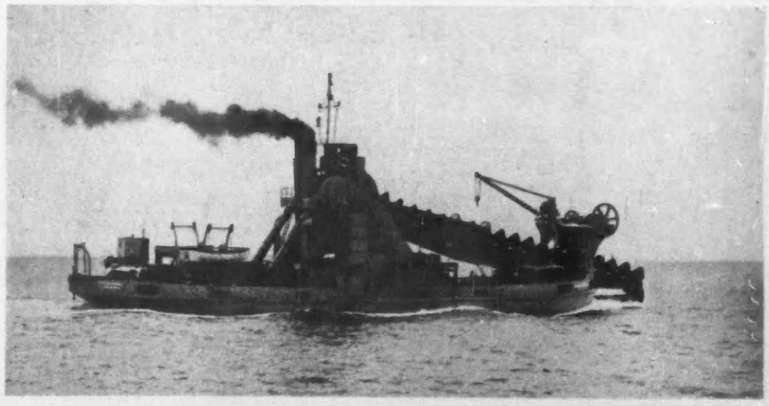

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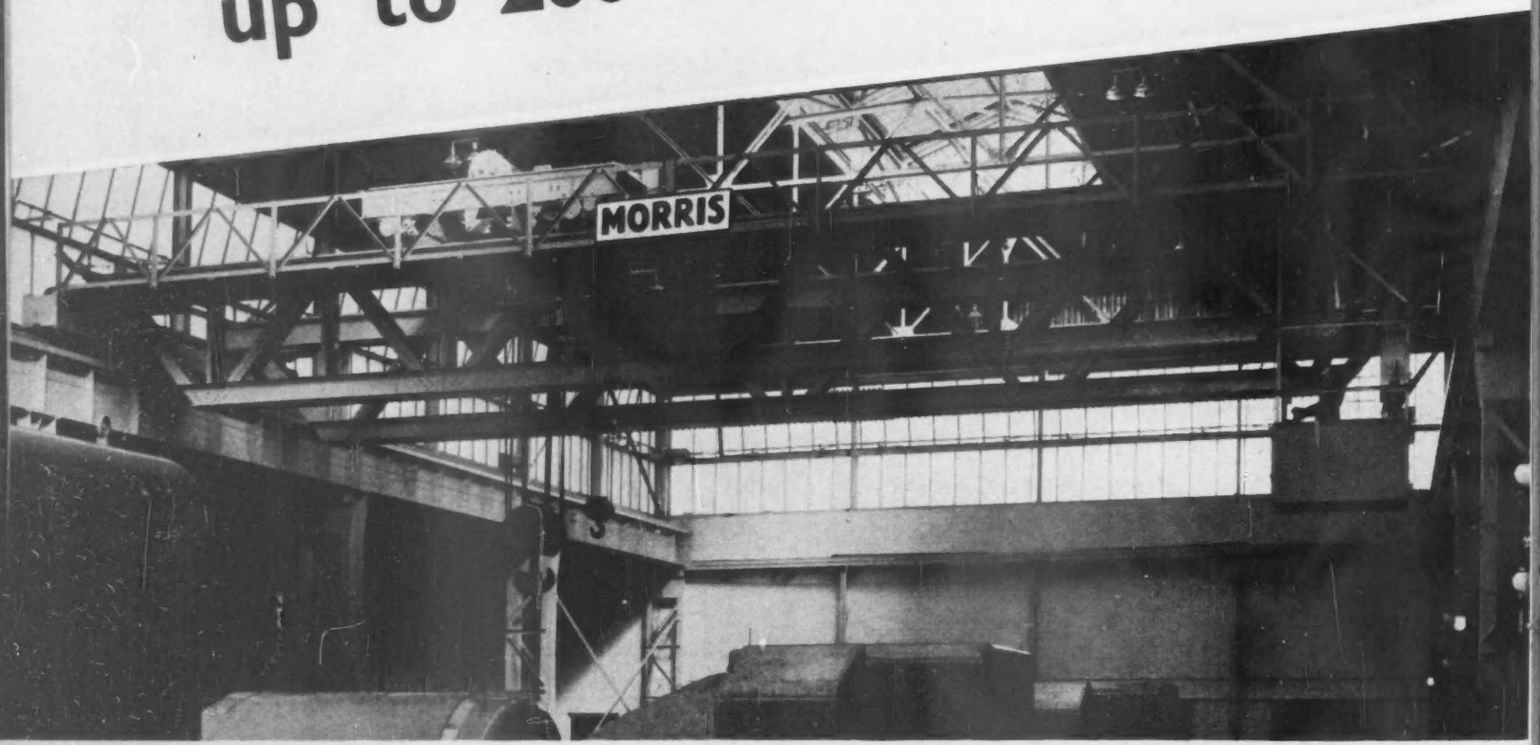

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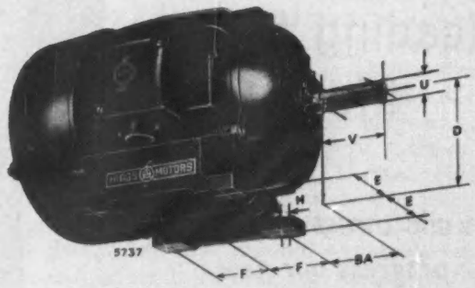

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3	2	1	½	D182	4½	3⅞	2½	2⅛	7/16	1⅛	3	5/16	¼
5	3	2&1½	1	D184	4½	3⅞	2½	2⅛	7/16	1⅛	3	5/16	¼
7½	5	3	2&1½	D213	5½	4½	2½	3½	7/16	1⅜	3⅜	¼	¼
10	7½	5	3	D215	5½	4½	3½	3½	7/16	1⅜	3⅜	¼	¼
15	10	7½	5	D254	6½	5	4½	4½	9/16	1⅝	4⅛	7/16	5/16
20	15	10	7½	D256	6½	5	5	4½	9/16	1⅝	4⅛	7/16	5/16
25	20	—	10	D284	7	5½	4½	4½	9/16	1⅝	5⅛	⅜	5/16
30	25	15	—	D286	7	5½	5½	4½	9/16	1⅝	5⅛	⅜	5/16
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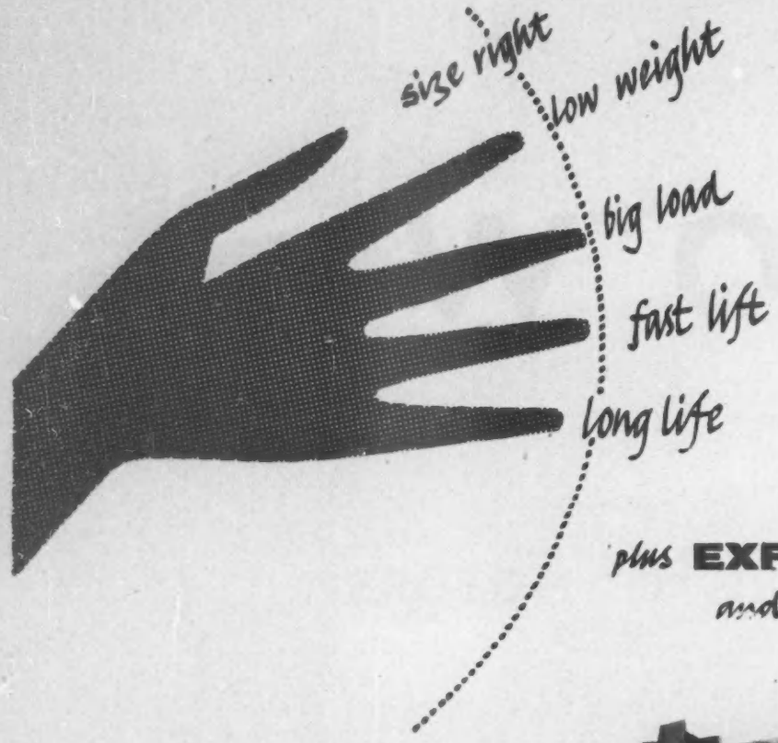

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THE ENGINEER

No. 5423 JANUARY 1, 1960 VOL. 209

RETROSPECT AND PROSPECT

Shakespeare suggested that there is a tide in the affairs of men which taken at the flood leads on to Fortune. If he was right, 1959 was not the best of years on which to gamble one's fortune. For, looking back, it can be seen that for engineers it was in 1958, not 1959, that a real flood tide of interest was reached. Few years, indeed, have ever been so eventful for engineers. Then came 1959, the year that ended last night. It, too, was full of interest for engineers but much less full than 1958. The tide seems to have started to ebb. If so, it would not be surprising if this New Year of 1960 proved dull by comparison with 1959, although, as always, new developments will be brewing which, though unseen and unheard of by the multitude, will certainly prove sufficient within a year or two to lead to a new spring tide of interest. How soon, for example, will it be before men land on the moon ? How long must we wait before power is generated from the nuclear fusion process ? How many months or years will pass before a nuclear power plant is propelling a British ship ? When will commercial aircraft be regularly exceeding the speed of sound ? Where does the future of the " Hovercraft " lie ? It crossed the Channel in 1959. When will a similar device cross the Atlantic ? Or has it a brighter future over land ? Remarkable possibilities can be foreseen for vintage years in the future, more exciting perhaps even than those of 1958 and much more exciting than those of 1959.

Ventures Into Space

Unhappily for the West—for there are overtones relating to the delivery of warlike weapons—the story of space exploration during 1959 was dominated by Russian achievements and rather embittered by American failures. At the very beginning of the year—to be more precise on January 2—the Russians launched what was intended to be a lunar probe. It missed the Moon (if it was ever intended to hit it) by some thousands of miles, but as it was at that time 228,000 miles from the earth the miss was in fact a near one. The object, having a weight of about 1½ tons went on to enter an orbit around the Sun. It was the first time in history that man had ever flung an object clean off this planet into interplanetary space. Were the measurements of astronomers sufficiently accurate, it would no doubt be possible to detect that there was in consequence a disturbance of the orbit of the earth round the Sun !

By September the Russians were ready again. At precisely two minutes past ten on the morning of September 13 the nose capsule of a Russian rocket—termed by the Russians " Lunik II "—landed on the Moon. Some trepidation was thereby caused because biologists regard it as of very high importance that the Moon shall not be contaminated by any living thing before man actually lands on its surface ; so that if life should eventually be found to exist there it will be proof that it was generated independently of that on earth. Fortunately the Russians seem to have appreciated the point because they went to great trouble to decontaminate the rocket before it was launched and again, through some kind of mechanism, just before it landed on the Moon. But the really remarkable thing about the whole affair, very well appreciated by " rocketeers," though less well realised by the public at large, was the degree of accuracy in launching and in guiding the object that was displayed. For the object travelled over 236,000 miles to hit the Moon which was travelling, roughly at right angles to its course, at about 2200 miles an hour !

Technically—that is as an engineering product—" Lunik II " was an achievement of the first magnitude. But the scientists were a little disappointed. For transmissions from the object's instruments ceased when it collided with the surface of the Moon. Thus the scientific value of its trip was confined to the short period during which it was travelling outwards from the earth. Disappointment vanished, however, only just over three weeks later. For on October 4 the Russians announced that " Lunik III " which weighs 613 lb was on its way towards the Moon ; that it was intended to miss it ; that it was to pass behind it and photograph the other side of it ; and that it would return to the vicinity of the earth and transmit back to the earth the photographs it had obtained. And so, to the very great credit of Russian engineers and scientists, it came to pass. Nor does it detract appreciably from that credit that there is some suggestion that the object approached the Moon a little less closely than was intended—figures issued by the Russians before it reached the vicinity of the Moon did not wholly accord with figures for the orbit issued afterwards. What was demonstrated was the high technical mastery of the problem of placing a rocket in or at least very close to a desired orbit. Unquestionably in that field the Russians showed themselves well ahead of the Americans. The implications for mankind are discussed at the end of this article.

An agreement was reached during the year that British scientific instruments should be sent into space by American rockets. The " Scout " rocket is to be the vehicle and at the most some 200 lb of instruments could be put into orbit. The agreement, though very welcome to British scientists, since it gives them the opportunity to participate in space research, proved less welcome to engineers, who had to rest content with a Governmental promise that studies would be continued to see whether British rocket missiles such as " Blue Streak " and " Black Knight " can be adapted for space research. As a consequence of the agreement with the U.S.A. the cost of space research to Britain will be reduced to mere hundreds of thousands of pounds.

Transport

Let us come down to earth again ; and let us confine attention for the moment to this country alone. In the

field of transport the most important event of 1959 was unquestionably the opening of the M1 motorway and the St. Albans by-pass to traffic. The existence of this substantial length of motorway may well have quite profound effects upon the people of this country and their thinking about road and rail problems. For anyone who has travelled along this quite short length of really modern roadway will very likely arrive at two conclusions. The first is that on no other road is driving so utterly boring ; and the second is that motorways provide so safe a means of getting from one place to another quickly without travelling at excessive speed that the country ought as soon as possible to have many more miles of them. There are other possible implications. What, for example, is going to be the effect upon British car and commercial vehicle design ? Necessarily, if many more miles of motorway are built, cars and commercial vehicles will have to be designed for continuous high-speed operation. If so, will there be a trend back towards streamlined body design ? Will overdrive become a standard fitting or will there be a tendency to raise back-axle ratios and provide more ratios in the gearbox ?

There are implications for the railways too—rather unpleasant ones ! Clearly if cars and commercial vehicles can be designed to travel over long lengths of motorways at speeds comparable with those of express passenger and freight trains the railways are in danger of losing one of the few advantages they at present possess over road transport, in the ability to carry passengers and freight long distances much faster than it can be done by road. However, the railways look like retaining for a long while into the future the advantage of being able to run at high speed right into the hearts of large cities. By contrast it is said that at certain hours of the day it takes a road vehicle as long to travel from the southern end of the new motorway into the centre of London, a distance of some fifteen miles, as to travel all the way to that end of the motorway from Birmingham, not far short of ninety miles ! The point emphasised is the need to ease the congestion of city streets. Many observers maintain that the only effectual way of solving the problems of cities is the construction through them of something more or less comparable to motorways ; it is a very costly way but it is the way chosen by many American cities and it is being attempted in a number of European cities too. By contrast a " Committee on London's Roads " which reported in August seemed to regard as audacious even so conservative a proposal as a proposed expenditure of up to £10,000,000 a year on London's roads.

Nuclear Power

The past year was not particularly notable in the field of nuclear power. Dounreay power station went critical towards the end of the year, some months later than was originally planned. As most engineers know, it is an advanced fast breeder reactor employing liquid sodium-potassium as the coolant and having a thorium blanket around the reactor core in which new reactive material will breed. Many months are likely to pass before it reaches full power ; and there are many problems to be elucidated before any truly commercial station can be built using this process.

Another event of the year was the announcement by the Government that seven groups of firms interested in nuclear reactors, in addition to the Atomic Energy Authority itself, had submitted to it designs for marine nuclear reactors. The gas-cooled graphite-moderated reactor, of course, figured among them. But so did no less than five designs based upon other practices. Just before Christmas there came a further announcement that tenders were to be called for the construction of two reactors presumably regarded as promising. The chosen kinds were the boiling water reactor and the organic-liquid-moderated reactor. Very possibly the gas-cooled graphite-moderated type has been excluded on the grounds that its performance and its cost can be sufficiently well estimated from actual practice with land stations ; and, no doubt, the pressurised water reactor has been excluded because a reactor of that type is to be installed in the new submarine " Dreadnought " which was launched during 1959.

For the rest, though an order for a power station to be erected in Japan was secured, the industrial consortia in this country came to an even firmer and sadder appreciation than before that not many orders are likely to be forthcoming either from at home or abroad at least until nuclear power costs can be proved to be no greater than those of conventional power stations.

Conventional Power

Looking back into the past it can again and again be observed that when challenged by something novel the " conventional " often shows an unexpected power of vigorous development. Never, for example, were better sailing ships built than after the advent of the steamship. And the steam locomotive—in the hands of Chapelon—has reached close to perfection only at the very time when it is yielding supremacy in France to electricity. So it has proved with conventional power stations. Size and economy go together. The first 200MW steam power set ever to be installed in this country is already in operation at High Marnham ; but of still greater significance there are on order, as this New Year starts, a 275MW set and, upon two shafts, a 550MW set. Each of those two sets will have a single boiler ! Each will generate electricity substantially more cheaply than any existing station ; and substantially more cheaply than the advocates of nuclear power counted upon as possible some years ago when planning the nuclear power programme.

Civil Engineering

In the records of civil engineers 1959 will have the unhappy distinction of being that in which, for the first time ever, an arch dam failed. Early in December the Malpasset dam in the South of France burst, with terrible consequences for the little town of Frejus a few miles downstream. The dam was a thin arch structure 60m high above the stream bed creating a reservoir with a storage of 25,000,000 cubic metres. An official inquiry is being held into the failure and, no doubt, the French authorities will in due course publish its findings. In the meanwhile all that can be said is that the impression conveyed by photographs is that it was one of the abutments which failed, not that the arch itself gave way.

But the year was also one which will be remembered for the completion of one of the world's greatest civil engineering projects. In June, the St. Lawrence Seaway was declared open by H.M. The Queen. Ocean-going ships can now penetrate far into the North American Continent, as far, indeed, as Chicago, for example. What the consequences will be it is difficult to foresee. But one of them must be a lowering of transport costs between Europe and the Middle West of the U.S.A.

There was one other event of 1959 which must be mentioned—drought ! A shortage of rainfall in England and Wales between May and October revealed the inadequacy in a number of places of water storage

facilities in this country, and in other places a failure to realise that " firm " supplies from existing sources were not equal to possible rates of demand. Shortage of water came near to closing down one important industrial area. Powerful reinforcement was given to those who argue that in Britain water supply should be under some form of central control and that it is absurd to suppose that storage and distribution can be adequate when there are still over 900 separate water authorities.

Iron and Steel and Coal

If only because Omar's " Moving Finger " can be seen so clearly to be at work one event of 1959 in the steel industry needs recording here. A large steel company in this country issued some details of a plan to install six electric arc furnaces in the near future, each of 110 tons capacity. What is remarkable about that plan is that the furnaces are to be used for the production of ordinary steels. Presumably the directors of the company know what they are about ! The expectation clearly is that by the time the installation is complete (or very soon afterwards) electric furnaces will be able to compete economically with open-hearth furnaces for the production of ordinary steels. In conjunction with an observable trend towards the use of continuous casting processes, there is a suggestion of something quite revolutionary happening in the steel industry.

The nationalised coal industry remained in trouble during 1959. Only a very few years ago the industry was being heavily criticised by almost everyone for not producing enough coal and for its lack of boldness in planning future output. In 1959 the output of the industry, though no larger than that of the previous year—it is likely to amount to about 204 million tons—exceeded demand by about 10,000,000 tons. The industry is now being heavily criticised for producing too much coal ! Stocks continued to grow and they now exceed 50,000,000 tons. How, it is being asked, are they to be disposed of ? For few seem to think that even the big recovery in industrial output which was certainly under way at the end of 1959 will so far raise the demand for coal that supply will fall below demand. But, for ourselves, we wonder. Gloom in the industry may prove, after all, exaggerated.

Economics

Economically on this first day of a New Year it is more pleasing to look forward than back. For though statistics are somewhat lacking we have a strong impression that output in the engineering industries is climbing. One of the indications is that though the output of the steel industry fell well below capacity during 1959 the industry was operating at 95 per cent of capacity as the year reached its end. Another indication was that consumer goods industries were booming at the end of the year ; so that capital goods industries should soon benefit in 1960.

Looking further into the future, the Convention, now being finally signed, for the setting up of a Free Trade Area amongst seven European countries, the U.K., Norway, Sweden, Denmark, Portugal, Switzerland, and Austria, may have profound effects in increasing this country's trade with those countries. Within a few years barriers to trade among them in manufactured goods will all be down. At present about 10 per cent of this country's exports go to those countries. What will be the percentage in ten years' time ? It is perhaps of even greater importance to ask the question whether any agreement will soon be reached to prevent any kind of trade war between the Free Trade nations and the six nations which have set up the European Economic Community, to which at present about 12 per cent of this country's exports go.

Where do we go from Here ?

Where are we all going ? For close on fifteen years man has seemed to be hesitating close to the brink of a war between conflicting ideologies. The Western nations —perhaps conceitedly—have believed that it is they who have preserved peace, by resisting Russian aggression. They believed themselves to be doing so by possessing a deterrent in the form, at first, of the atomic bomb (and, when the Russians at length acquired that bomb) by having the H-bomb when the Russians had not got it. But by the start of 1959 the Russians had a stock of H-bombs too ; and last year they demonstrated with decided aplomb with space research rockets that they had also as effective a means of delivering warheads as the Americans or the British. In fact the deterrent upon which the West has depended became in 1959 a weapon of suicide for so small a nation as ours ; and even for so large a country as the U.S.A., a weapon only of reprisal, no longer something which could be used as a deterrent to which an enemy has no reply. The change ought to have, and no doubt is having, an influence on defence thinking. But much more to our present point it seems to be having an influence on world political thinking. For faced by the threat that even a minor war might turn into a suicidal major one, the nations, great and small, seem to be approaching implicitly (though certainly not in writing) an agreement to outlaw war altogether.

The possibility of reaching a more explicit agreement is in the air in a year in which there is to be a Summit Meeting in Paris in May. It is worth asking, therefore, what would a trend towards disarmament mean for engineers ? Much, surely, and most of it good ! There would be a turning over of an immense research and productive effort at present concentrated upon destruction to the doing of more constructive things. One of those constructive things might well be found in an adaptation of the Marshall Plan idea, to the benefit of all under-developed nations. At present, far from gaining upon the more highly industrialised nations, the less well-developed nations are falling further behind in their living standards. If that rather dangerous state of affairs is to be altered, then the West, as Professor Blackett pointed out in his Presidential Address to the British Association in 1957, must be prepared to pour very large doses of capital into the under-developed countries to help them to attain what has been termed a " take-off into sustained growth." Equipment will be needed for power generation, for transport, and for primary producing industries. There will be little if any hope that the capital will ever be repaid. The reward to the West will lie in a reduction of tension between the have and have-not countries, and in the creation of new markets for their consumer goods. It is an immensely stimulating idea to engineers since much of the work to be done would require their services.

May we all hope, therefore, at the beginning of a year in which a Summit Meeting is to be held, that both Mr. Eisenhower and Mr. Krushchev will have some such conceptions in mind. It is, of course, far too much to hope that all tension between East and West will soon be relieved. But a beginning might be made were there to start a competition between them as to which could most rapidly and effectively advance the economies of the more backward countries. A dream ? No doubt ! But sometimes even dreams come true !

The Royal Navy—1959

The Naval Situation

With little more than two years to run of the 1957 five-year defence plan—which concentrates on measures to prevent, rather than to wage, war—no immediate change is to be expected in the size of our operational fleet. This consists of three aircraft carriers, a commando aircraft carrier and three cruisers, supported by destroyers, frigates and submarines. There is thus little doubt that in the meantime several more wartime vessels will be scrapped. The Royal Navy still has eight wartime cruisers, three or four of which should be sufficient to provide reliefs for the three "Tiger" class cruisers of the operational fleet while refitting or undergoing repair. The seven front line aircraft carriers now available are barely enough to maintain four in the operational fleet, but in accordance with present policy, the wartime carrier "Magnificent" and the hull of another carrier—on which no work has been done since the war—are also likely to be disposed of in the near future, in addition to a number of wartime destroyers and frigates.

All seven carriers and the three "Tiger" class cruisers, however, were laid down during the war and though they have since been reconstructed and modernised, urgent consideration will have to be given in 1963 to a replacement building programme. Despite the need to continue our contribution to the Allied deterrent as long as the German problem remains unsolved, Britain must have a larger fleet with modern weapons and power plants, even for a limited war. And large ships nowadays take a long time to build.

By 1963, moreover, rockets in quantity will be supplementing the manned bomber for delivering the H-missile. The solid-propellant naval intermediate range rocket "Polaris" is still under development and requires greater range and a warhead with increased explosive power before it will equal the land-based rocket as an effective deterrent. But if, as the Americans believe, both its range and the size of its warhead can be much increased, a sea-borne rocket of this type may well prove an equally effective (and certainly much cheaper) supplement to the V-bomber as our contribution to the Allied deterrent. The cost of each of the rocket-launching submarines now under construction in the United States is over £36,000,000 and Britain cannot afford very large sums of this nature for vessels whose sole function is to act as a deterrent. The primary task of the Royal Navy is, directly or indirectly, to defend the sea communications. Ballistic rockets, however, have no recoil and do not require extensive and complicated radar installations to guide them to their target after they are fired, as is the case with anti-aircraft guided missiles. There may thus be no technical reason why some of our new large ships should not be constructed to perform a dual role. Heavy cruisers might be built with a gun armament forward for the defence of the sea communications, with the after part earmarked for the stowage and launching of "Polaris" rockets. The rockets might well be supplied by the United States under the Mutual Defence Aid Programme. Accurate launching in any kind of seaway might prove difficult, however.

None can forecast how long Britain—and Europe—would continue to require imports in the event of an H-bomb war. To judge by the 1957 White Paper, on which our defence plan is based, the British Government believes that it would not be long. Indeed the small contribution which the Royal Navy is making to N.A.T.O. seems further evidence of this view. On the other hand the Soviet Navy of some 300 oversea submarines, thirty-two cruisers and 4000 aircraft would seem purposeless if Russia intends to try and gain her ends by waging war with thermo-nuclear weapons. Is it not more likely that she visualises that her new policy of bringing the under-developed countries within her orbit might lead to a maritime war fought outside the Continent of Europe, with conventional forces and weapons? This now appears to be the greatest danger facing us. To meet it a strong Royal Navy is essential if the main burden of defending the sea routes is not also to be placed on the United States. It is well to note that S.H.A.P.E. planners not only recognise this danger but admit that N.A.T.O. maritime forces may not be sufficient to deal with it. They plan, however, on the extremely doubtful assumption that if the N.A.T.O. lifeline were endangered by Soviet submarines, we should at once resort to the H-missile—and thus commit suicide. Who would decide when the danger point had arrived? In both world wars it was not reached until we had been fighting for three years.

The cost of the new large ships which must inevitably be built soon will be heavy. A cruiser laid down to-day would cost ten times that of a pre-war vessel of similar size. But the additional cost of partly arming her with "Polaris" rockets would be relatively small. The rockets would be in lieu of the after 6in guns, with all the machinery and equipment required to operate them. Moreover it cannot be doubted that, if rocket sites were only to be found in ships, the political agitation against Britain having these missiles would soon die a natural death. In brief, it seems that if the "Polaris" sea-borne rocket can be developed as an effective deterrent, compared with the land-based "Blue Streak," we might well consider adopting it at the end of our present five-year defence plan. Meanwhile this review is concerned with the Royal Navy as it is to-day; and the number, types and performance of our existing ships will be discussed in the following paragraphs in relation to the duties which may be assigned to them under that plan.

The Role of the Royal Navy

Before discussing the ships of the Royal Navy, it would be well to note the tasks they would be required to undertake in any war of the future. The Navy's role in time of peace—now more commonly called "the cold war"—has never been in question. By showing the flag in foreign ports, by the appearance of the White Ensign in an area of unrest, the mere presence of a British warship acts as a deterrent to further trouble. Our new frigates, which will before long replace our wartime frigates now used to show the flag in far distant ports, may not be so impressive as the cruiser squadron of pre-war days. None the less they are fine, powerful looking vessels and well able to uphold Britain's prestige in under-developed countries. Nor does anyone need convincing of the Navy's value in limited war—the Korean and Suez campaigns are but two modern examples of the vital part played by the Royal Navy in providing air cover and close support for the Army. Indeed, with the reduction in the number of oversea bases now at our disposal, the Royal Navy's task in limited war is becoming more and more important.

But with Soviet-built submarines and aircraft now available to the Chinese, Middle Eastern and other under-developed countries, our ships must be capable of doing more than merely getting to the scene quickly—they must have modern weapons

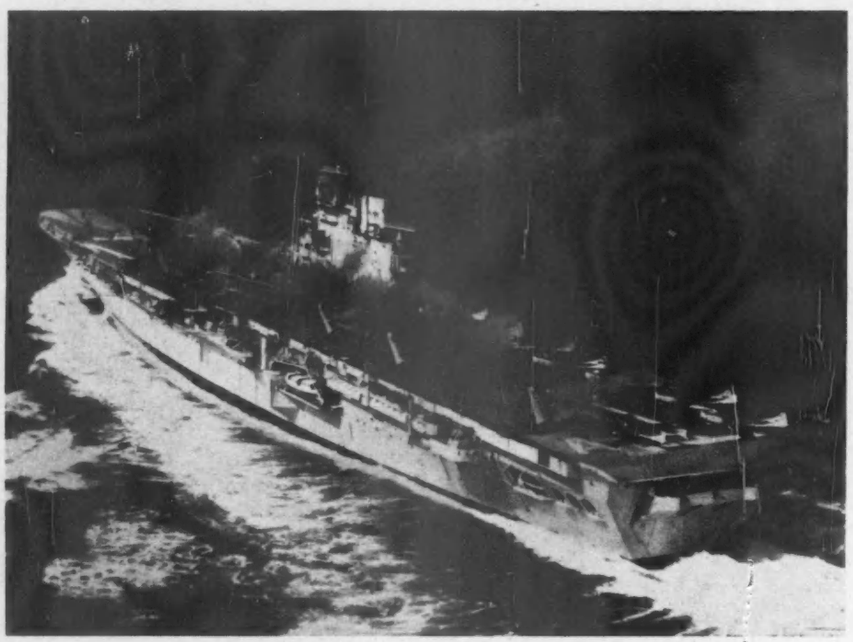


Fig. 1—The 22,000-ton carrier "Albion," laid down in 1944 and completed 1954, preparing to fly-off jet aircraft

Fig. 2—The carrier "Ark Royal," 43,340 tons, was laid down in 1943 and completed in 1955. Her electronic equipment is being brought up to date

and aircraft. Three of our seven front-line carriers may well be under reconstruction or refitting or out of action for other reasons. And if some of the remainder are to have their flight decks encumbered with lorries and other heavy equipment required by the troops, as has been the practice in recent campaigns, seven will be insufficient to meet our needs. Finally, a possible major war has to be considered. Despite the arguments of naval enthusiasts who maintain that nuclear attack on this country would still leave millions of people requiring food and other imports, it is generally believed that the Defence White Paper, 1957, presents the true picture. The British people are convinced that no adequate protection can be provided against nuclear bombardment and they question, in these circumstances, the need for imports and for the Merchant Navy and Royal Navy to convey them. None the less there is growing interest in the Royal Navy because of the belief, now held by many entitled to speak with authority, in the possibility of a major war fought with conventional forces and weapons mainly at sea and outside the Continent of Europe. The Royal Navy would in that event be required for its traditional role of guarding the sea communications.

Aircraft Carriers.—Britain's last remaining battleship, H.M.S. "Vanguard," which for the past two or three years has been in reserve and used as an accommodation and training ship, is earmarked for breaking up. The aircraft carrier has thus become the largest and most important fighting vessel in our fleet, though she has not, as is commonly believed, replaced the battleship as the capital ship. The battleship was designed to fight the most powerful surface vessel which could be employed to gain and maintain control of the sea communications, and the most powerful ship in the Soviet navy is a cruiser. It is thus the cruiser which, under existing conditions, is the capital ship and she must be prepared to protect the carrier from attack by hostile cruisers, particularly when the carrier's own aircraft are engaged elsewhere and not available to defend her. On the other hand, the Pacific operations in the last war showed that the carrier has greatly extended the striking power of maritime forces. Whether in a war fought with nuclear or conventional weapons, she must be large enough to operate aircraft capable of attacking targets in coastal areas, as well as at sea, and to fight land-based defending aircraft whose performance is constantly improving. The Americans indeed have built giant carriers of 60,000 tons—and are building still larger vessels—to supplement or, if necessary, to replace their land-based deterrent power. They are able to operate heavy bombers with a 1000 mile range and are equipped also to fire the 10000 mile "Regulus" guided flying bomb. Britain, mainly for financial reasons, is meanwhile awaiting further developments in nuclear power plants before starting a building programme to replace her wartime carriers. Though their hulls are old, they have been reconstructed and modernised and, when all have been refitted, will be capable of operating the new strike aircraft N.A. 39—one of the finest low-level strike aircraft yet designed, with a range of action sufficient to attack enemy harbours and war potential factories in coastal areas.

The seventh and latest of the Royal Navy's front-line carriers to be completed is the "Hermes" (see Plate 8), launched in 1953, which has now joined the Fleet. She is one of the four "Centaur" class—ships of 22,000 tons with a speed of 28 knots and a complement of forty-five aircraft. The other three are the "Centaur," the "Bulwark"—in hand for conversion as a commando carrier—and the "Albion" (Fig. 1). The "Centaur" and "Bulwark" are, with one cruiser, to provide the main units of our Far Eastern Fleet—deployed east of Suez. All four ships have the angled-deck, the latest type of arrester gear and have been or are being equipped with steam catapults. Though smaller and two or three knots slower than our three larger front-line carriers and, except for the "Hermes," without the very latest type of radar equipment, they are little inferior to them in the operational role. The 30,000-ton "Victorious," a pre-war designed carrier, which has been reconstructed and modernised at a cost of £15,000,000, is indeed one of the best equipped carriers in the world, with an air detection and direction system which is a spectacular advance on that installed in any other carrier. The electronic equipment of the two 43,300-ton carriers "Eagle" and "Ark Royal" (Fig. 2) is being brought up to a similar high standard. The latter has recently completed an eighteen months' overhaul and refit and the "Eagle" is now being taken in hand. They are 31½ knot ships and can accommodate twice the number of aircraft carried in the "Centaur" class. But for the defence of sea communications they are uneconomical and unnecessarily large, and it would seem that a nuclear-propelled carrier about the size of the "Victorious" would best meet the Royal Navy's future requirements.

Cruisers.—No ship has changed her function in a major war more drastically than the cruiser. Until the last war, her functions were to act as "the eyes" of the battle fleet and to control the trade routes. Subsequently she replaced the battleship in protecting the carrier from surface ship attack and also assisted the interceptor fighter to counter aircraft attack by providing long range anti-aircraft gun fire. More recently it became clear that for this latter task it was essential to equip ships with anti-aircraft guided missiles and successive First Lords emphasised that a replacement building programme for our cruisers must await the development of these missiles. Despite, however, the powerful cruisers of the Soviet Navy, aircraft attack is regarded as a more serious danger than surface ship attack, and the "Seaslug" guided missile has been earmarked for our four new escort vessels of destroyer type. Apart from financial considerations, it seems wise to wait for a cruiser replacement programme until the end of the present five-year defence plans in view of the continual progress in weapons and equipment. It may then be

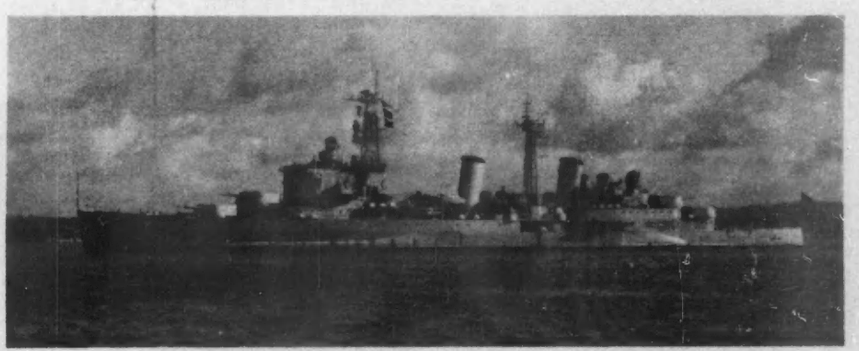


Fig. 3—H.M.S. "Belfast," of 11,550 tons, is the Navy's largest cruiser. She was completed as long ago as 1939 but has recently been modernised

practicable to build cruisers with nuclear power plants, to say nothing of the possibility of providing them with a part armament of ballistic rockets for deterrent purposes. It is worth noting in this connection that several of the larger carriers and cruisers of the United States Navy have an additional armament of 1000 mile range "Regulus" guided flying bombs. Though these are large missiles and require a good deal of space to accommodate them, they in no way detract from the primary function of the ship—be she a carrier or cruiser. The 28ft "Polaris" rockets are somewhat smaller. They could well be stowed in, and launched from, the after part of a heavy cruiser equipped with a gun and anti-aircraft guided missile armament in the fore part.

Meanwhile Britain has been gradually reducing her cruiser strength. This is in accordance with the present policy of retaining only such vessels as have been modernised and are still effective fighting units, and of keeping them ready for sea at short notice. Five cruisers were earmarked for scrapping in 1958 ; four more—the "Superb," "Euryalus," "Jamaica" and "Kenya"—were placed on the disposal list in 1959 ; and the "Newfoundland" and "Ceylon" have recently been sold to Peru, leaving only eight wartime cruisers, of which H.M.S. "Belfast" (Fig. 3) is one, and the three "Tiger" class. The "Tiger," (see Plate 8), the first of this class, was commissioned at John Brown's Yard, Clydebank, in March. Her 3in and 6in guns, capable of engaging air or surface targets by visual or radar methods, are not surpassed by the guns in any other navy. She is fitted with a comprehensive gun direction system which enables all her four 6in guns, mounted in two twin turrets and equally effective in the surface and anti-aircraft roles, to be controlled by radar. By the end of 1962 we shall be left with only the three "Tiger" class and three or four of the wartime cruisers to replace them during refits. A cruiser is a self-reliant and self-contained fighting unit, capable of steaming at high speed in rough seas. It is true that her reconnaissance function has largely been taken over by the aircraft carrier. But she is a particularly valuable fighting ship in all forms of war. Unless, indeed, it is suggested that the H-bomb has ruled out war at sea, or that we are to rely entirely on the United States, it is difficult to see how even the Royal Navy can deal with thirty-two Soviet cruisers with only the three "Tiger" class.

Destroyers, Frigates and Lesser Vessels.—The destroyer's function has also been changed by the elimination of the battleship, though a formation of these vessels may well still be used to attack a carrier at night. Under modern conditions, however, protection for both the Fleet and merchant ships against underwater or air attack is the main consideration. Thirty-three of the 110 wartime destroyers remaining in 1951, when the rearmament programme began, have in fact been converted to fast anti-submarine escort frigates and there are now building four fleet escort vessels of destroyer type whose main task will be to provide anti-aircraft defence with the "Seaslug" guided missile. A notable feature of these four ships is their combined gas turbine and steam turbine propulsion which when steaming at sea will enable them to double their available horsepower at a moment's notice. To accommodate the "Seaslug" missile and the extensive and complicated installations required to guide them to their target, a larger vessel than the conventional destroyer is required. From the scale model the new fleet escort vessels look more like small cruisers of between 4000 and 5000 tons. But with six more destroyers earmarked last year for disposal, the Royal Navy, even with these four new vessels, will only have fifty-three destroyers available—including the eight fine "Daring" class completed since the war—as compared with 150 modern Soviet ships of the same type. Most of the latter are powerful vessels, armed with four 5in guns and eight to ten 21in torpedo tubes, with a speed of 36 to 38 knots. How many destroyers shall be built in the future is anybody's guess. But the day is now over of the relatively small destroyer armed with guns ; her anti-submarine function and "maid-of-all-work" duties have now largely been taken over by the anti-submarine frigate.

Britain has certainly done well by N.A.T.O. in providing during the past few years a substantial number of first-rate frigates and minesweeping vessels, though it is significant to note that most, if not all, of these ships were ordered or projected before the new defence plan of 1957. By the end of this year, thirty-three of the forty-four new frigates authorised under the rearmament programme will have joined the fleet. Included in the forty-four are five aircraft direction vessels (Fig. 4) to give carriers early warning of approaching air attack ; four frigates with a powerful anti-aircraft armament of four 5in guns in twin turrets (Fig. 5), to provide anti-aircraft protection for merchant ships ; and seven general purpose vessels capable of carrying out both these duties, besides their primary task as anti-submarine ships. These last will carry a helicopter and, like the four new fleet escort vessels, will have combined gas turbine and steam turbine propulsion. All R.N. anti-submarine frigates—including those converted from destroyers—are being fitted with the latest and greatly improved detection and classification equipment and with the new anti-submarine "homing" torpedo. Meanwhile, in accordance with present policy, an increasing number of 19-knot wartime frigates are being sold or scrapped year by year, though some will still be required for a few years for "showing the Flag."

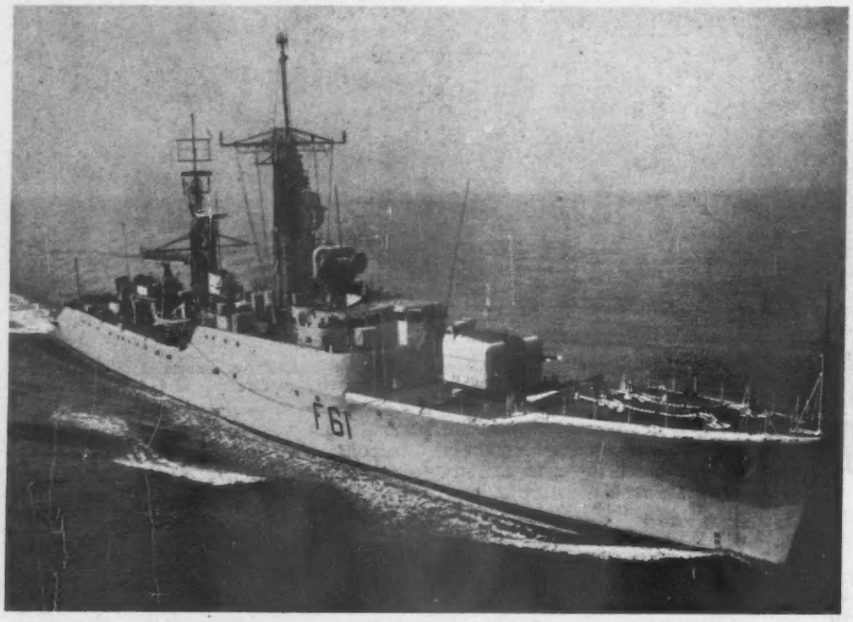


Fig. 4—H.M.S. "Llandaff," of 1730 tons, is an aircraft direction frigate. She was completed in 1958

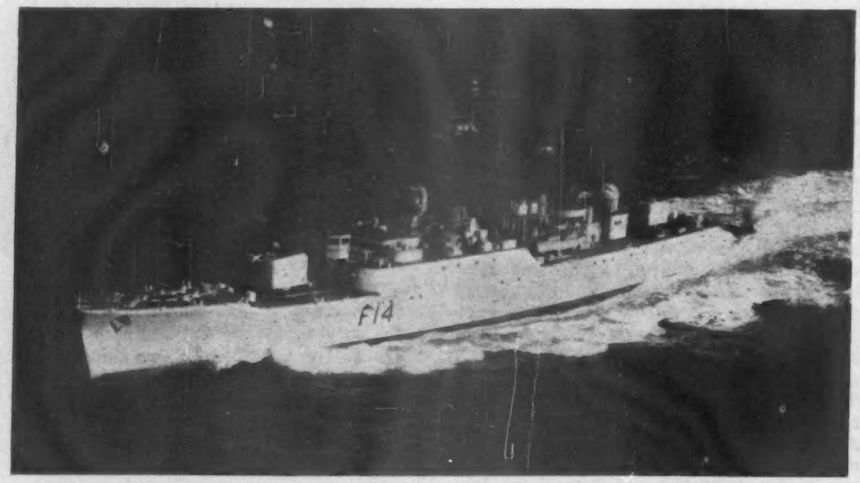


Fig. 5—H.M.S. "Leopard," of 1738 tons, is an anti-aircraft frigate. She was completed in 1957

The current Navy Estimates show a total strength of 232 minesweepers of a new type, only two or three of which still remain to be completed. Their hulls are constructed mainly of non-magnetic material and they are intended to deal with all types of mines—contact, magnetic and influence. The larger, or coastal, type will operate in shipping channels near the coast; the smaller, or inshore, type are for sweeping estuaries and other shallow waters (Fig. 6). Both are diesel driven. Though all are of recent construction, the vast majority have necessarily to be kept in reserve, and it might well be in N.A.T.O.'s best interests if the smaller powers took over a number of these vessels. If they assumed greater responsibility for minesweeping in the Channel and North Sea, it would release British naval personnel and resources for larger ships at the outbreak of war. The Royal Navy has also some twenty-seven wartime ocean-going minesweepers whose original function was to sweep ahead of the fleet. But, as in the case of other wartime vessels, they are gradually being disposed of. Finally there are eighteen recently constructed seaward defence craft for detecting submarines in the approaches to defended ports and a dozen fast patrol craft—with four more building. A few of these craft are still used operationally and for training, but the coastal forces which did such brilliant work in the last war are now maintained only on a skeleton basis.

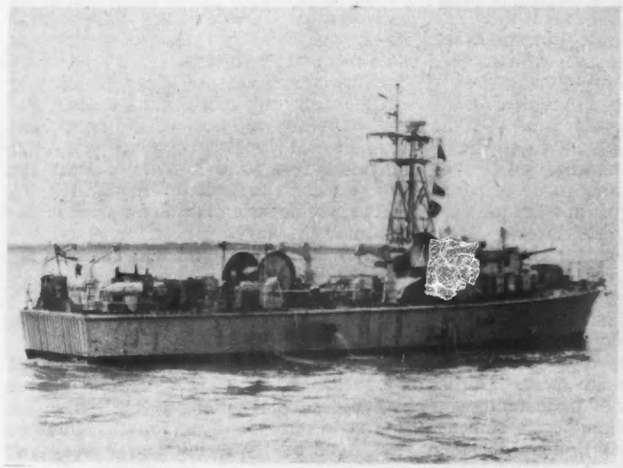


Fig. 6—H.M.S. "Chelsham," of 120 tons, is an inshore minesweeper. She is propelled by two Paxman diesel engines

Fig. 7—The Saunders-Roe P.531 "Wasp," for use in anti-submarine vessels

The Navies of the Commonwealth

Despite the anxiety of some of the Commonwealth countries to avoid taking sides in the cold war, there is little doubt that N.A.T.O. would have the full co-operation of the whole Commonwealth in the event of a major war. The post-war period has witnessed a substantial increase in the Commonwealth navies and this development has been greatly assisted by the transfer of ships, in the form of gifts, loans or sales, from the Royal Navy. Moreover, some of the Dominions have new ships under construction in British yards. Two frigates are building for the Royal New Zealand Navy, two frigates for the South African Navy—which has already received six coastal minesweepers and two seaward defence vessels originally intended for the Royal Navy. The Indian Navy has ordered six new frigates, two of which are already completed, and has bought the carrier "Hercules," now being modernised, and three "Hunt" class frigates. The Pakistan Navy has two Royal Navy destroyers under conversion as anti-submarine frigates and has bought another wartime destroyer. Seaward defence vessels and coastal and inshore minesweepers have also been transferred as gifts to the Royal Malayan Navy, the Nigerian Navy and the Royal East African Navy.

The Submarine and Anti-Submarine Situation To-day

Submarine.—In a debate in the Commons early last year on the Navy Estimates, the Parliamentary Secretary, Admiralty, referring to the voyage of the "Nautilus" under the North Pole in 1958, said "it is now recognised that nuclear-powered submarines represent a major scientific break-through." This remark was made five years after the "Nautilus" went to sea, three years after she had steamed 60,000 miles on about 8 lb of nuclear fuel (much of the distance submerged) at speeds "of between 15 and 20 knots," and with the knowledge that the United States had twenty-nine nuclear-powered submarines built, building or authorised. Six months ago, the Duke of Edinburgh spoke even more emphatically when he "laid the keel" of the first British submarine of this type, the "Dreadnought" (see Plate 8). "The atomic submarine," he said, "expensive though she may be, places in our hands a weapon whose wide development possibilities make it of infinite value to our protection and prestige." Every expert in submarines, or in naval tactics will agree wholeheartedly with these views. But is anything being done to convince the taxpayer who has to foot the bill? "How is it," he asks, "that the nuclear-powered submarine—so we are officially informed—can dive 'below 400ft,' when conventional submarines in the first world war were forced by depth charge attack below that depth and still survived?" "How is it that official reference is made to a submerged speed of 'up to 20 knots' when fifteen years ago the Germans were building a submarine which, they claimed, could proceed at 25 knots submerged for 150 miles?" He has in mind that the performance of the British experimental submarine, "Explorer," with engines based on the German model, seems to prove that the German claim was justified. Finally, he asks, "Now that we have full access to the technical knowledge and practical experience acquired by the United States—which, if words have any meaning, has recently built a nuclear-powered submarine that is very much faster than the 'Nautilus'—why are we content to lay down only one of a similar type?"

The answer is, of course, primarily, lack of finance. Britain still has to take her share in preventing war which is absorbing a substantial and increasing part of our defence budget. Moreover the feeling still persists—even in the highest quarters—that the deterrent might possibly fail to deter, in which event the war is unlikely to go on for long. Lastly we have still to complete a programme of diesel-electric drive submarines planned some years ago when we were concentrating our nuclear knowledge and resources on the building of nuclear power stations. They are first rate conventionally powered submarines, and we may be sure that they are a great improvement on the German type XXI, which were in Allied hands after the war and which have a submerged speed of 16–17 knots for one hour and of up to 5 knots for four or five days. There are to be thirteen of these submarines—eight "Porpoise" class and five similar but improved vessels of the "Oberon" class. Eleven of these will have joined the Fleet by the end of this year. All are fitted with both air and surface warning radar which can be operated also at periscope depth. They are equipped with air conditioning and sea water distilling plants and have oxygen replenishment and carbon dioxide and hydrogen eliminators, thus providing for a submerged patrol of several days. It would be a great mistake to scrap this submarine building programme even if it were financially possible to do so. For patrolling and operating in waters controlled by the enemy—the original and still very important function of a submarine—they could scarcely be bettered.

None the less it is essential to realise that nuclear propulsion, while giving the surface warship almost unlimited endurance at high speed and many other advantages, has revolutionised the submarine. It has changed her from a relatively cumbersome and slow-moving craft—which, however, nearly brought this country to her knees in the two world wars—into a submerged vessel which is as fast and as manœuvrable as a fast surface ship. It is clearly desirable for security reasons that her maximum speed

should for as long as possible be concealed from potential enemies. But from our knowledge of the submerged performance required of submarines to-day and of the speeds they have already attained, it is clear that "up to 20 knots" is a considerable understatement. Speeds of 25 knots may be regarded as the normal maximum, with speeds of 5 or even 10 knots higher with specially designed hulls. Though nuclear-powered submarines may be designed for some particular task—such as radar picket duty—they fall broadly into three types. The normal patrol submarine; the very fast "hunter-killer" submarine with a specially designed hull; and the large guided missile or still larger ballistic rocket-launching submarine. As stated above, Britain will soon have thirteen new conventionally-powered submarines, eminently satisfactory for carrying out a submarine's normal duty of patrolling in enemy waters. A flotilla of these patrol submarines is now to be based on Singapore. The rocket-launching submarine would certainly be of great value to the Soviet navy for bombarding industrial areas and towns, and the United States is now building nine of this type in the belief that developments will give the naval rocket "Polaris" a range of 1500 miles. Launching their rockets unexpectedly in the vicinity of an enemy's coast, they should provide the N.A.T.O. nations with the most effective possible deterrent.

But the cost of each submarine of this type now building in the United States is estimated at £36,000,000 and Britain just cannot afford this large sum for a vessel whose sole function is to provide a deterrent. The Royal Navy's primary duty is the defence of the sea communications, which makes the "hunter-killer" submarine one of our most urgent requirements. Rocket-launching submarines—and indeed any other type of submarine equipped with "homing" torpedoes—will not deliberately come within range of a surface asdic vessel. The most effective method of locating and destroying them is for another nuclear-powered submarine to patrol submerged. She must be fast and relatively small, armed with homing torpedoes and equipped with the latest and improved type of asdic and hydrophone installations. It is thus highly satisfactory that Britain is hastening the construction of the "Dreadnought" by purchasing a complete power plant and propulsion machinery similar to those installed in the United States submarine "Skipjack" commissioned just over a year ago. The propulsion plant is being made available to Rolls-Royce and Vickers-Armstrongs, the firms which are combining in the design and construction of the "Dreadnought." The latter's hull is also being based on the "Skipjack's" hull, which in turn is based on the hull of the experimental United States submarine "Albacore"—conventionally powered and completed in 1953. This hull has the form of a whale with a rounded instead of a flat-topped deck and with the bow diving planes transferred to the conning tower (or "sail" as the Americans call it, because it is shaped like a fish's dorsal fin). Despite her conventional power plant, the "Albacore" is credited with a submerged speed in excess of that of the nuclear-powered "Nautilus." The "marriage" of an "Albacore" hull with a nuclear power plant has given rise to fantastic reports of the submerged speed of the "Skipjack" class. In any event they are much faster than the "Nautilus," and it would not be surprising if their speed was at least 35 knots. The surface displacement of the class varies between 2300 and 3000 tons and they have only one shaft with a five-bladed propeller. Their reactors are similar to the "Nautilus" plant but embody major improvements in design, including a simpler method of core-changing. It is much to be hoped that Britain will not delay in building a flotilla of these submarines on the ground that we must have proof of the success of the "Dreadnought." They are the kind of vessels most urgently required by the N.A.T.O. nations.

Anti-Submarine.—As emphasised a year ago in our review of the Royal Navy, the problem of anti-submarine defence primarily depends for its solution on increasing the range of detecting devices. Indeed the major share of the money allocated for naval research and development is earmarked for the improvement of measures to detect and destroy an enemy below and above the surface of the sea. Our new anti-submarine vessels will have an asdic installation with a performance five times better than those now in use. Plans have been made to fit this equipment in all modern frigates and other anti-submarine vessels at present in service. The new homing torpedo—literally a self-guided missile—will also be installed in all these ships and in anti-submarine aircraft. Apart from the serious threat to an island people implicit in the immense Soviet submarine force, we have now to be prepared to deal with the submarine in a limited war. The Chinese Communists already have twenty of these vessels and the United Arab Republic nine. The Soviet Navy is known to have several missile launching submarines and when reinforced by more modern, nuclear propelled underwater ships, with their silent running engines, it will be extremely difficult to locate them. During the past year the policy of streamlining and concentrating naval shore establishments wherever practicable has brought together at Portland both the new Underwater Weapon Establishment and the Underwater Detection Establishment. This is achieving a marked improvement in efficiency in anti-submarine research, development and training. Together with the flotilla of fast submarines and modern anti-submarine vessels at Portland—to which a helicopter flying school has now been added—for the training of the Navy's anti-submarine personnel, the proximity of these two establishments will lead to a valuable cross-fertilisation of scientific and naval ideas in the undersea warfare sphere.

Little information is available regarding the performance of the devices for detecting submerged submarines. But in general it may be said that, as radar cannot detect a submerged vessel, research and development are being concentrated on improving the measures used in World War II—asdics, and also the hydrophone which the Germans had already brought to a high state of efficiency before the war ended. It seems hardly necessary to point out that a relatively small, fast nuclear powered submarine patrolling submerged could employ both these measures to her own advantage. The practicability of operating helicopters from small ships is also a great advance. With their ability to hover, they are ideal for the employment of the sonobuoy—which, with the aid of a hydrophone, picks up and transmits to ships or aircraft in wireless contact the noise of a submarine's propellors. Dipping asdics can also be lowered from helicopters to transmit back echoes from a submarine to the operator above.

Improvements in devices for destroying a detected submarine have kept pace with the improved performance of detection measures. The most formidable weapon is the atomic depth charge designed for dropping from an aircraft or helicopter. As yet, however, there have been no reliable reports that this weapon can be adapted for use by surface ships, having regard to the safety factor required. Another effective weapon is the homing torpedo which can be fired from a surface ship, aircraft or patrolling submarine. And, finally, there is the post-war designed three-barrelled anti-submarine mortar which is "married" to the asdic set. Controlled electronically, the three mortar bombs are fired automatically in a pattern and aimed at the position where the submarine is expected to be when they explode. But in concluding this section, it must be emphasised that the main problem is to locate a submerged submarine at any depth down to 1000ft. Missile launching submarines and indeed any submarine with a homing torpedo will do their utmost to avoid coming within asdic range of an anti-submarine surface ship. Without being unduly pessimistic, one would perhaps do well to take note in this connection of the present position as seen by Admiral Cooper, Commander of the U.S. anti-submarine defence force. "What is urgently needed," he says, "is a technological breakthrough to permit an aircraft to scan 50 to 75 miles of ocean at a time down to a depth of 1500ft. Present methods of detection fall so far short of this that the U.S. Navy has been forced to throw nearly every type of unit that floats or flies into the detection effort."

The Fleet Air Arm

The 30,000-ton aircraft carrier "Victorious" completed over a year ago—a pre-war designed carrier entirely reconstructed and converted into one of the finest medium-size vessels of her type—has had a busy year working up to full operational efficiency and carrying out exercises and trials (Fig. 8) with the Royal Navy's new generation of aircraft. Her own squadron of "Scimitars"—the first to be embarked—has given every satisfaction in N.A.T.O. exercises, particularly in regard to the rate of climb of this aircraft. The Vickers-Armstrongs "Scimitar" is the Navy's latest fighter—a single-seat twin-jet strike fighter capable of delivering tactical A-bombs or of employment as an interceptor or reconnaissance aircraft. Powered by two Rolls-Royce "Avon" engines, it is able to sustain air speeds well above Mach 1 at sea-level. Power controls are fitted and "blown flaps" reduce the safe approach speed for deck landing. After extensive night landing and take-off trials in the "Victorious" early last year, the de Havilland "Sea Vixen" also entered operational squadron service with the commissioning of No. 892 Squadron at Yeovilton in July. These two-seat day and night all weather fighters are to replace the "Sea Venom" as the Navy's all-weather fighter. Powered by two Rolls-Royce "Avon" turbojet engines, they have an armament of "Firestreak" infra-red air-to-air guided missiles and twenty-eight 2in air-to-air rockets in two batteries carried internally on retractable racks in the bottom of the fuselage.

The Navy's new strike aircraft—the Blackburn NA39—made its first appearance at sea last year by carrying out several landings and take-offs in the "Victorious." Powered by de Havilland "Gyron Junior" engines, the NA39 is believed to be superior to any aircraft in the world in its specialised role of a low-level strike aircraft. Some time must

elapse before these machines are in operational service, but the output up to date is well within the terms of the Ministry of Aviation contract schedule. The Fairey "Gannet" early warning A.E.W. Mark 3 is another new aircraft which meets one of the Navy's more urgent requirements. Early warning aircraft greatly increase the range of the ship's radar in detecting impending aircraft attack, the picture on the "Gannet's" screen being reproduced by radar link on the ship's screen and thus acting as an airborne intelligence centre. For anti-submarine duties, however, the earlier "Gannets" are likely in due course to be replaced by the helicopter, which can now be operated from most types of ships and, because of its ability to hover, is vastly superior to fixed-wing aircraft for anti-submarine work. The production order for the gas-turbine-powered Westland "Wessex" indicates the importance which the Admiralty attaches to the helicopter, despite the temporary withdrawal from service recently of the Westland "Whirlwind" Mark 7, due to engine trouble. An interesting and highly successful series of trials has been carried out in recent months with the lightweight Saunders-Roe "Wasp" (Fig. 7) as an anti-submarine helicopter operated from the sterns of ships of frigate type. The importance of the helicopter for submarine work was emphasised by the then Parliamentary Secretary, Admiralty, in the debate on the Navy Estimates, when he referred to the opening, at Portland, in April last year, of the first Service helicopter airfield in the United Kingdom. In the same debate the introduction was announced of a new scheme for the entry of Fleet Air Arm helicopter pilots. Young men who wish to serve in that capacity and have the necessary qualifications will be given special five-year commissions on the Supplementary List of the Royal Navy—age limits on entry 17 to 23 years. Britain's seventh front line carrier —H.M.S. "Hermes"—recently completed and commissioned—is a modernised version of her 22,000-ton sister ships "Albion," "Centaur" (now equipped with two steam catapults) and "Bulwark," which is under conversion as a Commando carrier.

Fig. 8—The 30,000-ton carrier "Victorious" refuelling at sea from the R.F.A. "Tide Flow." Note the fully-angled deck

Research and Development

The Royal Navy's research and development programmes continue to have as their primary aim the improvement of measures for locating and destroying submarines and aircraft. The new asdic installations have a performance five times better than those at present in use in the Fleet and the introduction of helicopters—which can now be operated from most types of ships—is making the anti-submarine forces more effective and flexible. The gas turbine "Wessex" helicopter is already in production for naval use. On the anti-aircraft side, automatic means are being developed for handling tactical information received from radar warning and electronic data in our air defence systems. A small surface-to-air guided weapon—the "Seacat"—is also under development to replace the 40mm gun throughout the Fleet and the missile is now undergoing tests. Meanwhile, H.M.S. "Girdle Ness"—the guided weapons trials ship—after recommissioning, sailed in June for Malta to carry out further trials in the Mediterranean of the medium range anti-aircraft guided missile "Seaslug" (Fig. 9). In the field of engineering research, naval engineer officers, scientists and industry, working as a team, have been concentrating on propulsion machinery which will give ships increased endurance along with reductions in the weight and size of machinery, thus providing more space for weapons and equipment. A notable advance has been made with the Royal Navy's new general purpose frigates which, like the four new guided missile destroyers, are to be equipped with a combined steam turbine and gas turbine plant. The proportion of the weight of these ships devoted to weapons and associated equipment has been increased from 15 to 25 per cent. At the same time, the greater efficiency of the new machinery has increased the frigate's endurance by 25 per cent—equivalent to a saving of more than £250,000 on fuel costs during the ship's life.

With the purchase of a complete nuclear power plant and propulsion machinery for the submarine "Dreadnought" from the United States and the access gained to American practical experience of nuclear propulsion power plants, every effort is being made to design an economic nuclear merchant ship. The Marine Nuclear Propulsion Committee, under the chairmanship of the Civil Lord of the Admiralty, is examining designs for nuclear propulsion plants submitted by the Atomic Energy Authority and several British nuclear engineering firms. All these systems possess different characteristics in terms of weight, size, capital and operating costs and other technical factors and not all of them are equally advanced for use in surface ships. Concurrently under examination are methods of financing the first ship and the problems of safety in the nuclear ships themselves and at their ports of call. A new chair of Nuclear Science and Technology has been established at the Royal Naval College, Greenwich, which is responsible for the advanced scientific and technological education of naval and Admiralty civilian officers. Courses are being held for design specialists, technical officers and commanding officers and others of the seaman specialisation. With a view to investigating the behaviour, under high rates of loading, of the various steels and welded joints used in warship construction, the Admiralty has installed a large impact machine at the Naval Construction Research Establishment, Dunfermline. It is capable of delivering 500,000ft lb of energy to a test specimen and though intended primarily for application in the building of warships, it is expected to be of value in other branches of engineering and to steelmakers.

Though the Royal Navy is now officially credited with having the "homing torpedo," it is necessary to study authoritative reports from the United States to ascertain new developments on the material side. The guided power bomb, it appears, is by no means the exclusive property of the air forces. The air-to-surface guided missile "Bullpup" is now in operational service with United States naval aircraft squadrons. It is a missile of 540 lb, 11ft long and 1ft in diameter, has supersonic speed with a 250 lb non-nuclear warhead. The "Bullpup" is the sixth guided missile—including the surface-to-surface "Regulus"—to become operational in the United States Fleet. A new navy all-weather jet fighter with a speed twice that of sound is also in production for delivery to the United States Fleet this year. Launched by catapult, it will be capable of landing on less than 300ft of aircraft carrier deck. Another interesting development is a super-sensitive television camera to indicate faint particles of light in the dark ice above, when a submarine is proceeding under an ice field. It was used by the "Skate" in her voyage under the North Pole to enable her to spot areas of thin ice through which she could safely surface. The U.S. Department of Defence has announced that this television system has capabilities for night viewing far beyond any previously achieved.

Dockyards and Maintenance

The net Navy Estimates approved by Parliament for the current year were £370,700,000—over £31,000,000 more than the original Estimates for the previous year. Provision was made for a £33,000,000 increase in the cost of contract work for ships and aircraft and their equipment and for more expenditure on submarine nuclear propulsion. The reorganisation and reduction of shore establishments have continued in accordance with the policy of concentrating the Navy's shore support. During

1959 underwater research and development establishments have been concentrated at Portland and above-water research and development establishments at Portsdown. The rundown of Hong Kong Dockyard has now been completed, a year after the closing of Trincomalee Naval Base. Sheerness Dockyard has been sold to Buildings Developments, Ltd., which intends to develop it for engineering production and to erect new industrial buildings as required. The Royal Marine Barracks and the Naval Gunwharf at Chatham have also been sold —to Messrs. William Palfrey, Ltd. The Nore Command will be abolished by 1961, only the dockyard at Chatham being retained. In March H.M. Dockyard Malta was formally handed over to the purchaser —Messrs. Bailey (Malta), Ltd.—who are developing it for commercial work and to create a commercial ship-repairing centre which will be the envy of the world. The Royal Navy will continue to use Malta as a naval base and will remain responsible for certain dockyard services, such as the port auxiliary service and the electrical generating station. Meanwhile the Mediterranean Fleet Clearance Diving Team are still clearing the harbour of unexploded mines and bombs.

The Admiralty's decision to dispose of its holdings in Messrs. S. G. Brown, Ltd., led to a clash in the Commons. The firm manufactures gyroscopic compass equipment and other high precision instruments, and Opposition speakers suggested that the firm was being disposed of because under public control it had become a profitable organisation. In fact, the disposal of the firm is merely another aspect of the change in defence policy due to the nuclear weapon which has already resulted, *inter alia*, in a rundown in the size of the Reserve Fleet and the consequent reduced requirements for dockyard capacity. During the current financial year, some £6,000,000 is being spent on machinery for shore establishments. New work is being started in the Royal Dockyards worth nearly £2,500,000. About £1,000,000 is being spent on barracks and other single living accommodation and a further 400 married quarters should be completed by next April. It is intended to maintain furnished livings for officers and men at a level of 4500. Admiralty civilian staffs at home and abroad numbered 152,000 in April, 1959—a reduction of 30,000 in two years—and reductions are still in progress. The major reorganisation of the Royal Dockyards is going ahead as planned, with Chatham Dockyard as the pilot dockyard. As outlined in these columns a year ago, the reorganisation involves changing the management structure from a professional to a functional character and developing improved techniques for production and planning control. The Controller's Department at the Admiralty has already been reorganised on the same principles in four departments—Dockyards and Maintenance, Aircraft, Weapons, and Ships. Another innovation has been the setting-up of a new Works Department to absorb the present Civil Engineer-in-Chief's Department. It will also take over the responsibility, hitherto resting on the Royal Dockyards, for carrying out electrical and mechanical work in shore establishments other than the Royal Dockyards. As a further step in improving the Fleet train, there are chartering a number of 16,000–18,000-ton tankers to replace the smaller 11,000-ton "Dale" and "Wave" class R.F.A. freighting tankers. The first of these—the M.V. "George Lyons," now renamed R.F.A. "Appleleaf" (Fig. 9) was taken over in April on a long-term bareboat charter.

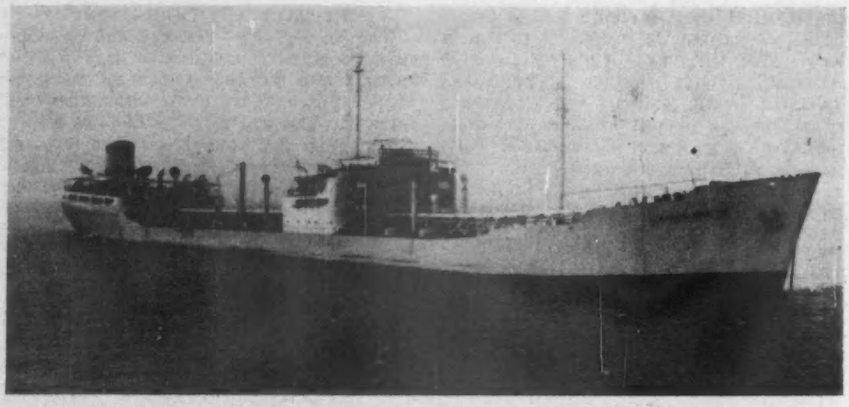


Fig. 9—The R.F.A. "Appleleaf," one of the 18,000-ton tankers replacing the "Wave" class

Personnel

During the current financial year Vote "A" strength will fall from 106,000 to about 102,000, the aim being an eventual strength of 88,000 officers and adult ratings. Regular recruiting, except for artificer apprentices, is now up to the level required and the re-engagement position is back to its pre-war level. About 60 per cent of those who joined for twelve years after the war have signed on for another ten years for pension. Further changes were announced last year both in the standard required for entry and the training of Dartmouth cadets. The boys must have two "A" level passes in the G.C.E. in addition to some passes in the "O" level. A minimum of two "A" level passes in mathematics and physics is demanded for engineering and electrical specialists, who will be educated to reach degree standard. The R.N.E. College, at Manadon, will give the majority of these officers a course leading to an honours degree in engineering and a few will go on to Cambridge or another university. Midshipmen will once again be found in seagoing ships under a new scheme for training cadets: their first year at Dartmouth and in the Training Ships will be devoted to the development of officer-like qualities, after which, at about nineteen years of age, they will learn the practical side at sea as midshipmen for one year. They will then return to Dartmouth—more mature and broader in outlook—to their academic naval education. The seaman specialist officer will in future have a 75 per cent chance of promotion to Commander's rank for the command of a ship instead of only 33 per cent as hitherto. The first entries under the new standards will be in Autumn, 1961, and thereafter there will only be one entry per annum.

The continuing shortage of artificer apprentice entries is both surprising and disappointing. The technical training offered is unsurpassed and is recognised for the award of the Ordinary National Certificate, thus qualifying the holder for civilian life. An artificer receives higher pay and quicker advancement than other naval ratings, and an average of 20 per cent achieve commissioned rank.

The Royal Naval Reserve—in which is now embodied the R.N. Volunteer Reserve —celebrated its centenary last year. It has provided the Royal Navy with a body of skilled officers and men for duty in emergency, and in 1910 a trawler section was added with fishermen enrolled with the rank of skipper to deal with the mine menace. The R.N. Volunteer Supplementary Reserve is now open to entrants who have had no previous naval service or seagoing experience. They will join with dormant commissions as Temporary Sub-Lieutenants R.N.R., to be confirmed in the event of call-up and emergency, until when there are no pay, promotion or allowances. Candidates for the engineering and electrical branches must have a suitable degree or have qualifications for Associate Membership of the Institution of Electrical or Mechanical Engineers. The heads of the non-seamen specialist branches of the General List of Naval Officers have now been given the new titles of Chief Naval Engineer Officer, Chief Naval Electrical Officer and Chief Supply and Secretarial Officer respectively. A substantial reduction in the numbers of Royal Marines serving afloat will enable the Admiralty to reform in April this year the 41 Commando Royal Marines. This unit, disbanded after the war, was reformed for the Korean campaign and took part in the historic break-out from the Chosin Reservoir. It was again disbanded in 1952.

Exercises and Activities

Though every opportunity is taken by H.M. ships to exercise with the other N.A.T.O. navies, there were only two large-scale N.A.T.O. exercises during the year—an anti-submarine exercise and an amphibious exercise—both in the Mediterranean. The S.E.A.T.O. navies carried out a big exercise in the Indian Ocean in April, designed to promote close working relationships, and this was followed in July by a large-scale Commonwealth exercise in the same area in which six Commonwealth navies took part. The Home and Mediterranean Fleets also carried out their customary combined exercise in the Spring, and visits by ships of both fleets were paid to several countries, including Spain, Portugal, Greece, the Scandinavian countries and Greenland. Home Fleet ships have also had to supplement the Fishery Protection Squadron in carrying out the Icelandic patrol—a distasteful task which, however, has provided valuable experience of work under Arctic conditions. At least one of H.M. ships has been constantly on patrol in each of the three pre-arranged 30-mile long "safe" fishing havens located between the 4 and 12 mile limits. H.M. the Queen honoured H.M.S. "Eagle"—prior to the vessel undergoing an extensive modernisation—by going to sea in her during April to watch a flying display by the squadrons of the Fleet Air Arm. Two months later she visited Gosport to present the first Queen's Colour to H.M.S. "Dolphin" for the Submarine Command.

Water Supply and Water Power

Walton South reservoir under construction for the Metropolitan Water Board (main contractor W. and C. French, Ltd.) is shown ABOVE, as it was last June, with the outlet works in the foreground. The reservoir will have a capacity of 4300 m.g., and will take five years to construct. The embankments are of ballast, with a mechanically-compacted clay core. See "The Engineer," February 1, 1957.

Lewiston generating station of the Power Authority of the State of New York is shown under construction BELOW. The station utilises the power available by treaty to the U.S. at Niagara Falls, and Lewiston is directly opposite the Canadian Sir Adam Beck–Niagara stations. Like the Canadian developments, a pumped storage scheme will be built above the head pond of Lewiston power station. First power is due to be generated early in 1961, the ultimate capacity being thirteen 150MW sets, with 300ft net head, at Lewiston, plus twelve pumping-generating sets, each of 20MW (generating) with reversible Francis pump/turbines at the Tuscarora station.

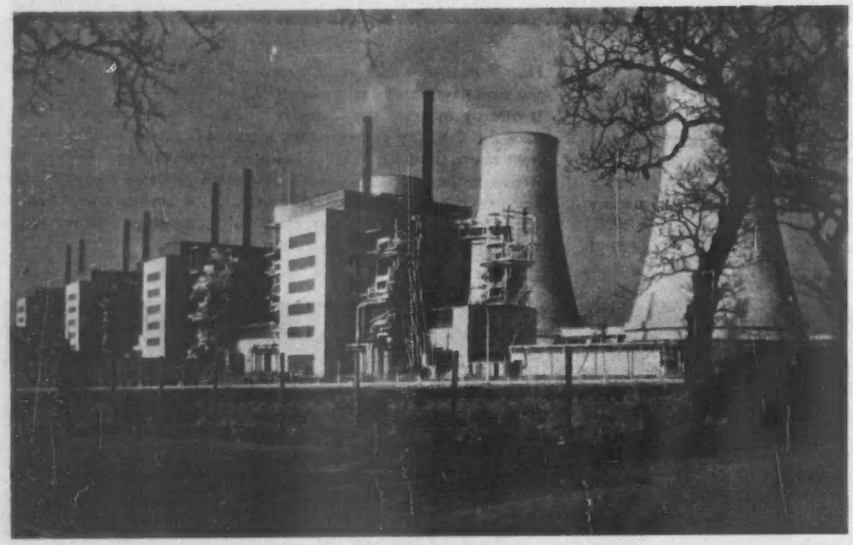
Nuclear Power Development in 1959

MORE and more does one realise that even the layman understands when one talks of atomic energy, and particularly nuclear power, that one is talking quite seriously about projects in this country which have come to be regarded as a feature of our present-day life and a serious competitor to other fuels in the field of electrical generation. Not so many have realised that the usefulness of the atom in the form of radioisotopes is now forming a regular pattern of our lives in the medical field and in the many industrial processes where radioisotopes can be used for measurement and for counting. Even radioactive tracer elements are being used for hydraulic surveys in rivers and tidal waters. The public, both layman and engineer, see quite clearly from the size of the works under construction on the reactors that the nuclear engineers are quite seriously erecting plants determined to affect our lives for many years to come.

Looking back on 1959, a year in which quite a lot has been accomplished in the nuclear power field, one again sees that considerable development has taken place, and several milestones have been passed in the peaceful uses of atomic energy in the service of mankind. Nothing quite so startling as the fusion reaction in ZETA (Zero Energy Thermonuclear Assembly) was made public in 1959, nor was anything so alarming as the Windscale incident to excite the imagination of the public, but in the serious field of reactor development there were some quite important results.

On November 14, the Atomic Energy Authority announced that the fast reactor at Dounreay had gone critical but would be run at low power for some time. This is the largest reactor of its kind in the world to have gone critical, although it is not designed for such a large output as the Enrico Fermi fast reactor now being built in the U.S.A. It represents a considerable experiment in the field of controlled fission reaction from fast neutrons instead of slow or thermalised neutrons. While it was made known some time ago that this reactor would not be started up until the latter half of 1959, the extra time permitted modifications to be carried out in the engineering detail in the light of further research and development. The final date was, however, affected to some extent by the drafting of engineers and scientists to other more urgent projects while the engineering changes were being carried out.

Chapelcross nuclear power station (illustrated here) was officially opened on May 2 (THE ENGINEER, May 8, 1959), although its first reactor came into operation at the end of 1958, and electricity had been exported to the South of Scotland Electricity Board's grid lines from February. Three of the reactors were brought up to power during the year, and the fourth reactor went critical in December. It is of interest, however, to note that, as at Calder, these reactors are producing power considerably in excess of the designed output. The output of electricity from Calder Hall to the National Grid now exceeds 1500 million units, and that from Chapelcross, to date, exceeds 200 million units. At the other end of the scale, the production of radioisotopes and their use in this country alone can be appreciated from the fact stated recently that some 560 factories in this country use isotopes in some form or another for industrial purposes.



Chapelcross nuclear power station opened in 1959

The considerations of the Fleck Committee which investigated the cause and implications of the fire in one of the Windscale reactors in 1957 continued through 1958 into 1959, and advantage was taken of the experience gained to improve the design, instrumentation and safety of the current British power producing reactors.

One effect of the nuclear power stations in the United Kingdom being of larger output than originally envisaged is that fewer of them will be placed by the electricity authorities in the first ten years, with the result that the five industrial consortia now working in this field have had to share a reduced number of stations. On August 15, the A.E.I.-John Thompson Company and the Nuclear Power Plant Company announced their intention to merge and submit joint tenders, thereby enabling some re-organisation to be carried out and savings to be effected primarily in the field of research and development. Subsequently, on September 25, a similar collaboration arrangement was announced by the G.E.C.–Simon Carves Group and the Atomic Power Construction Company. In some quarters, these mergers are looked on as a welcome development as the programme of nuclear power in the United Kingdom has not expanded as was originally expected, nor will the export market develop fully until experience is gained with the first large British stations. An event of considerable importance was the announcement by the Japan Atomic Power Company in Tokyo on April 3 that it had issued a Letter of Intent to the British General Electric Company for the construction of a 150MW nuclear power station at Tokai-Mura, some 70 miles north-east of Tokyo, the contract for which was signed last month by the president and vice-president in London.

International Events

Some indication of things to come may be drawn from the interest taken by representatives of the U.S.A., U.S.S.R., France, West Germany, Holland, Belgium, Italy, Sweden and Switzerland in the review of the research into controlled thermonuclear reactions which was undertaken at a Convention in London on April 29 and 30.

International discussions took place in Rome on the safety and location of nuclear plants and on radiation chemistry. Discussions also took place on the economics of nuclear energy at the symposium which was held within the International Exhibition of Electronics and Nuclear Energy which opened in Rome on June 15.

In the field of International Agreements, the U.K.-Euratom Agreement which was signed on February 4, must take precedence, as this agreement which is concluded in the first instance for a period of ten years is intended to provide for practical co-operation on the peaceful uses of atomic energy between institutions and individual industrial concerns in the United Kingdom and in the Euratom countries, and will thus open the Euratom market to reactors developed in Great Britain, and will help users in Euratom countries to gain experience in the field of natural uranium reactor technology.

Some time later, on March 23, an Agreement was signed at O.E.E.C. headquarters in Paris for joint development by the members of the European Nuclear Energy Agency for ultimate power generation purposes, of the high-temperature gas-cooled reactor at Winfrith Heath. This follows quickly on the boiling water reactor project at Halden in Norway.

In the field of technical collaboration, it is also interesting to note the agreement for collaboration on nuclear power projects between The General Electric Company, Ltd., of England and the Maschinenfabrik Augsburg-Nurnberg A.G. concern in West Germany.

Interest in British Reactors

As all British reactors are so far dependent on natural or only slightly enriched uranium as a fuel, great interest has been taken during the year in the fuel element production at Springfields. It is ten years since the first fuel elements were made there for the British experimental reactor at Harwell, and shortly afterwards for the Windscale production reactors in Cumberland. A completely new fuel element production plant has been laid out, which is capable of producing the fuel

elements for all the British nuclear power stations and for those which British contractors are building overseas. The new process for metallic uranium begins with crude uranium oxide and thereby eliminates the peroxide precipitation stage of the original process; while calcium reduction of uranium tetrafluoride was used originally to produce the uranium metal, subsequent development has shown that magnesium is a more satisfactory reducing agent. These two points help to show the extent to which the production of metallic uranium has undergone a change.

Each British industrial reactor design has a separate fuel element design and new plants at Springfields have been laid out which are capable of producing the fuel elements to varied specifications on separate production lines.

Continuing interest is shown in British power producing reactors of the graphite-moderated gas-cooled type, and the British consortia have been actively engaged in discussions, both in Commonwealth countries and in Europe. The authorities in these countries and their utility undertakings have also been in touch with the Atomic Energy Authority and have had preliminary discussions and visits to the Authority's reactors at Calder Hall and Chapelcross. Personnel from the Authority's Industrial Power Branch at Risley have been involved in discussions on reactor design, fuel element rating and general overall reactor performance. Other discussions have taken place on the transportation and re-processing of irradiated fuel.

In the field of reactors for marine propulsion, the committee set up under the chairmanship of the Civil Lord of the Admiralty with representatives of the shipping, shipbuilding and marine engineering industries, Lloyd's Register of Shipping, the Atomic Energy Authority and other interested Government Departments heard proposals by the Atomic Energy Authority and seven industrial concerns or groups for eight marine reactor systems, all possessing different characteristics in terms of weight, size, capital and operating cost. All eight of these systems have varying technical factors, and not all of them are equally advanced for early use. The main committee has, therefore, set up a technical sub-committee to assess these various proposals.

All these systems have had to be examined for safety by the Atomic Energy Authority and the Ministry of Transport. Meantime, the Ministry of Transport Committee on Marine Nuclear Safety continues its work already begun on the problems of safety in nuclear powered ships as well as in the ports and harbours in which they will follow their trade. The technical sub-committee studied not only the economics of the various systems but also the ways and means of financing the first nuclear ship.

It is interesting to note that the eight proposals put forward include, in addition to the advanced gas-cooled reactor system of the Atomic Energy Authority, a gas-cooled, graphite-moderated reactor system, in many ways similar to those being used in the large nuclear power stations, a high-temperature gas-cooled reactor system, a steam-cooled heavy-water reactor system, a direct-cycle boiling-water reactor system and a closed-cycle boiling-water reactor system, a pressurised-water reactor system, and an organic-liquid-moderated reactor. In December the Minister of Transport announced that the Government had accepted the recommendations of the Galbraith committee that tenders should be invited from "selected" firms for two systems (the boiling-water reactor and the organic-liquid-moderated reactor).

Two privately owned research reactors are also worthy of mention; first, the A.E.I.–John Thompson Company's "Merlin" reactor at Aldermaston Court, which is designed for an output of 5MW (thermal) and uses enriched Uranium 235 fuel with light water as a moderator, and the Hawker Siddeley Company's "Jason" reactor at Slough, which uses uranium dioxide fuel and is water-moderated. A similar reactor to "Jason" is being bought by the Atomic Energy Authority and is to be erected at Winfrith Heath. This version, which is to be in operation by the end of 1960, will be known as "Nestor" and will be modified for continuous operation up to 10KW (thermal) output.

Research and Development

Early in the year, the Atomic Energy Authority confirmed that it intended to proceed with the build-up of Winfrith Heath as an experimental reactor establishment which, on fission reactor development alone, would employ between 2000-3000 people by 1962.

One of the most important projects being commenced at Winfrith Heath (THE ENGINEER, Aug. 7, 1959) is, as mentioned earlier, the jointly run international project in the programme of the O.E.E.C.'s European Nuclear Energy Agency for the development of nuclear power for peaceful purposes on a Europe-wide basis. Six European countries, together with "Euratom," will combine in a joint investigation of the use of high-temperature gas-cooled reactors for nuclear power stations, and the new project known as "Dragon" will be based mainly on the construction of an experimental power-producing reactor of several megawatts output. Some ninety European engineers and scientists, together with approximately 160 from the U.K., will comprise the international staff of the "Dragon" project under Mr. C. A. Rennie, of the U.K.A.E.A., who is chief executive.

This new type of reactor introduces principles which have not yet been tried experimentally, hence the aim is to lay a firm foundation for the reactor technology of these systems on which future developments can be based. The reactor is expected to have relatively low capital construction costs and operate at a temperature in the region of 1000 deg. Cent.

Another project which is already nearing completion at Winfrith Heath is the Authority's zero energy reactor "Zenith," which will make an important contribution to the "Dragon" programme. It is primarily designed for reactor physics studies within the high-temperature gas-cooled concept, and will operate in the temperature regions mentioned above.

In the field of advanced gas-cooled reactors, it is important to note that during the year the Atomic Energy Authority signed an agreement with the United States Atomic Energy Commission for an interchange of information on the advanced gas-cooled reactor designs.

As is now well known, work is proceeding apace on the Authority's prototype advanced gas-cooled reactor at Windscale, the main purpose of which is to test various kinds of fuel under full reactor conditions. It is essentially a fuel element development reactor, and for this reason it has been designed to operate at 100MW of heat and to generate 30MW of electricity, as it will be most important for it to run at high power for prolonged periods.

It is visualised that nuclear power stations based on the advanced gas-cooled reactor (or A.G.R.) will become operational in the '60s and will use uranium oxide fuel canned in beryllium, or an alternative canning material.

Higher operating temperatures and heat ratings will be used which will consequently lead to greater efficiencies than can at present be achieved in the reactors being built in this country for power production, but the levels of radiation or neutron flux inside the reactor core and pressure vessel will be considerably higher. Two problems are raised by the more arduous conditions in the A.G.R.—those of reactor physics and of reactor materials, the most important material problem being to develop fuel elements which can withstand high burn-up under the exacting conditions of high temperature and high flux. As the reactor physics problems concern the behaviour of neutrons in the reactor, the importance of highly refined reactor physics lies in the very competitive nature of the present-day reactor design, which demands extremely careful optimisation of reactor cores.

In addition, the A.G.R. brings more problems of kinetics and stability with the more highly rated reactor core. As the fuel will be irradiated for a longer time, it will build up very substantial amounts of plutonium. The reactivity changes of such a system are very dependent, both on the fuel and moderator temperatures as well as the isotopic content of the fuel.

A new reactor known as "Hero," which is a hot experimental reactor of zero energy, will be built near the prototype advanced gas-cooled reactor, and work on this has already started. This reactor will make it possible for the physicists to carry out low-radiation-level measurements, and to experiment with several alternative fuel arrangements to obtain the best performance. Sensitive techniques will be available in "Hero" to carry out the necessary measurements at the lower radiation levels, but it is important to note that the graphite core, which is a structure 19ft in diameter and 19ft high, can be dismantled and rebuilt in a variety of ways. In this case the carbon dioxide will supply heat to the core instead of removing heat from it, and the reactor will employ clusters of pencil-like fuel elements of uranium oxide sealed in beryllium cans, just as will be employed in the A.G.R.

In addition, the Authority has been engaged during the year in a design study for a steam-cooled heavy-water reactor which has now reached the stage where the basic parameters and main design features will be discussed with the industrial consortia in the course of their usual technical collaboration.

In support of the Authority's reactor development programme, much fundamental and applied research work has been going on in the Authority's laboratories on questions of fuel element design, metallurgy and materials testing, together with experiments in heat transfer work, and an elaborate study of irradiated materials such as graphite, uranium and various canning materials.

Research

In the field of more fundamental research, it is interesting to note that the 50 MeV proton linear accelerator was accelerating protons to an energy of 50 MeV for the first time in July of this year. This is the first accelerator to come into operation at the National Institute for Research in Nuclear Science, and will be used by physicists from the universities and the Atomic Energy Authority working with a resident team at the Rutherford Laboratory. It is expected, when

in full operation, to have a proton beam of high intensity and very well defined energy; consequently it will be possible to do experiments of great value in the study of the interaction between nuclear particles.

The Authority has decided not to abandon ZETA, the Zero Energy Thermonuclear Assembly project; it will continue to provide information on controlled thermonuclear reactions, but has shown that the next fusion device to be built in Britain should aim to provide a more thorough knowledge of the basic physical laws governing the thermonuclear process and an experimental device to meet these requirements known as I.C.S.E. (Intermediate Current Stability Experiment) is at present being planned by the Authority.

The Authority's decision to set up a new establishment to deal with controlled thermonuclear research is already known; the work in this field will then be transferred from Harwell and Aldermaston to the new establishment which will be directed by Mr. J. B. Adams, at present Director of the Proton Synchrotron Group of the European Council for Nuclear Research (C.E.R.N.) near Geneva.

Gamma Radiation Processing Plant

An event recently announced which may be the forerunner of other important work is the pilot plant which the Atomic Energy Authority is now building at the Wantage Radiation Laboratories which will enable industrial firms already investigating the technical merit and commercial potentialities of irradiated materials to carry out full-scale trial runs of irradiation processes such as the sterilisation of medical equipment and the disinfestation of packaged products.

The plant will make use of the large quantities of radioactive material which will become available as the result of the chemical separation of the irradiated fuel returned from the nuclear power programme in the United Kingdom.

The plant is based on a unit package size of approximately 1 cubic foot and, to ensure full utilisation of the source, it will operate on a twenty-four hour per day basis. The cell will be loaded initially with 150,000 curies, but has been designed to house 500,000 curies of Cobalt 60.

Nuclear Power Stations in Britain

The construction of the first three stations in England at Bradwell, Berkeley and Hinkley Point has progressed steadily during the year, and it is interesting to note that the first large reactor pressure vessels at Berkeley and Bradwell have now been pressure tested. Work on the first station in Scotland at Hunterston was, unfortunately, brought to a standstill as far as pressure vessel and heat exchanger construction is concerned due to labour disputes.

Tenders for the new station at Trawsfynydd in North Wales were examined by the Central Electricity Generating Board and the Atomic Energy Authority acting as their consultants for the reactors, and a contract was awarded to the Atomic Power Construction Company, Ltd., who began work on site in the late summer.

It is significant, in connection with these first stations, that Lord Chandos disclosed during the annual general meeting of A.E.I. in April that considerable losses had been made on the station at Berkeley, due to the consortia's inability to assess the difficulties involved and the modifications required in this entirely new venture, but he went on to say that the knowledge gained, while probably unique in the world, would prove of very great value in the future. Later on, Sir Leslie Gamage announced publicly that the difficulties over the Hunterston project would also result in considerable losses to the G.E.C. and the company had decided, therefore, to put aside an allocation out of their profits for the year.

Design discussions will no doubt be going on between the Central Electricity Generating Board, the Atomic Energy Authority and the industrial consortia (of whom four Groups have already announced mergers) on the layout and the design requirements of the next two nuclear power stations which the C.E.G.B. intends to build at Dungeness in Kent and Sizewell in Suffolk, for which it is expected contracts will be awarded later this year.

The Dungeness station is likely to have an output in the range 500MW to 550MW, and the Sizewell station may, contrary to expectations last year, be of very much the same output. The latter site is still subject to permission being granted by the Local Planning Authority and the Minister of Power.

The Central Electricity Generating Board is, in addition, exploring the possibility of sites in other parts of England for nuclear stations, as the Board may require to build a total of twelve to fourteen stations to implement the first part of the Government's Nuclear Power Programme. The present trend, and a prudent one, to site these nuclear stations on remote parts of our coasts or on large estuaries, and the advent of larger and larger power outputs from each reactor, necessitates not only transmission at 275kV, but highlights the necessity for design work on extra high-voltage transmission at 380kV, or even higher.

These stations are basically designed for base load operation, but until the night load and week-end summer load in this country is increased by the use of thermal storage installations, three shift working in industry and other means, there is a limit to the number of nuclear stations which can be run as base load stations at a reasonably high load factor. However, it may yet be shown with present reactor designs that controlled reduction of power and increase of power can, if necessary, be undertaken, say, at week-ends, although it is not obviously economic to reduce the power output of the reactor to any appreciable extent. Not only is the life of the fuel elements to be considered as this may be adversely affected by a too rapid or too frequent change in operating temperature, but also the running costs at partial load operation are, to a great extent, dependent on the capital cost of the plant and therefore less favourable than on conventional power stations.

Further design work by the industrial consortia with the assistance of the Atomic Energy Authority may show that the capital cost of such stations can be reduced quite appreciably, and it is believed that there is considerable scope for development along these lines of the gas-cooled graphite-moderated reactors using magnesium-alloy-canned natural uranium fuel.

In addition, development of a civil version of the Atomic Energy Authority's advanced gas-cooled reactor may show still further savings in capital cost, together with a completely new conception of fuel utilisations and consequently fuel cost, despite the fact that individually more expensive fuel elements may be used.

Bearing in mind that the A.G.R. will probably use a ceramic fuel, say, uranium oxide instead of metallic uranium and beryllium or some other alternative canning material instead of magnesium alloy, a very much higher power rating can be achieved and higher temperatures, which will in turn give very much better steam conditions and consequently require physically smaller turbines for the same generated output.

While it is clear that the large scale research and development employed by the consortia on the original Calder type reactor will, together with improvements in engineering design and improved fabrication techniques, show considerable advances in the next ten years, it is possible that the A.G.R. will be developed on parallel lines to exploit the use of alternative fuels and the better steam conditions. It would be a mistaken impression that the changeover to a civil version of the A.G.R. could be rapid, as many metallurgical problems have to be resolved and the properties and compatibility of materials under higher temperatures and irradiation can only be known after in-pile experiments lasting for several years.

While it is true that the industrial consortia will undoubtedly carry out a great deal of research and design thinking on the more advanced kinds of reactor, they have sunk large sums of money into the design and development of the original Calder type reactor, and it is therefore clear that it will pay them to seek improvements in design which will give still more attractive capital costs and higher efficiency to these. One possibility which is being examined is the prestressed concrete pressure vessel with light steel lining which combines to give a cheaper pressure vessel with a biological shield combined. Alternative methods of blower drive and gas flow control also offer good rewards and are being studied exhaustively by the consortia.

While it is true that the Atomic Energy Authority is building the prototype A.G.R. with a view to its early development for power production purposes on a civil scale, and are undertaking design study and feasibility studies on other reactor systems culminating in the fast fission reactor (the prototype of which has now been built at Dounreay) it would be wrong to assume that each reactor system is going to supersede its predecessor within the space of a few years. If this country is going to develop power producing reactors within the framework of sensible economics, each system must be developed to its utmost, while the metallurgical and long-term irradiation problem of the next system is being studied.

Whereas in the U.S.A. attention has now been drawn to the need to develop a gas-cooled reactor, United Kingdom engineers are giving attention to water-moderated reactors, and in particular to the use of heavy water as a moderator, but it is not yet clear that the capital cost of such a plant will show an immediate gain over those of the more advanced type of gas-cooled reactor.

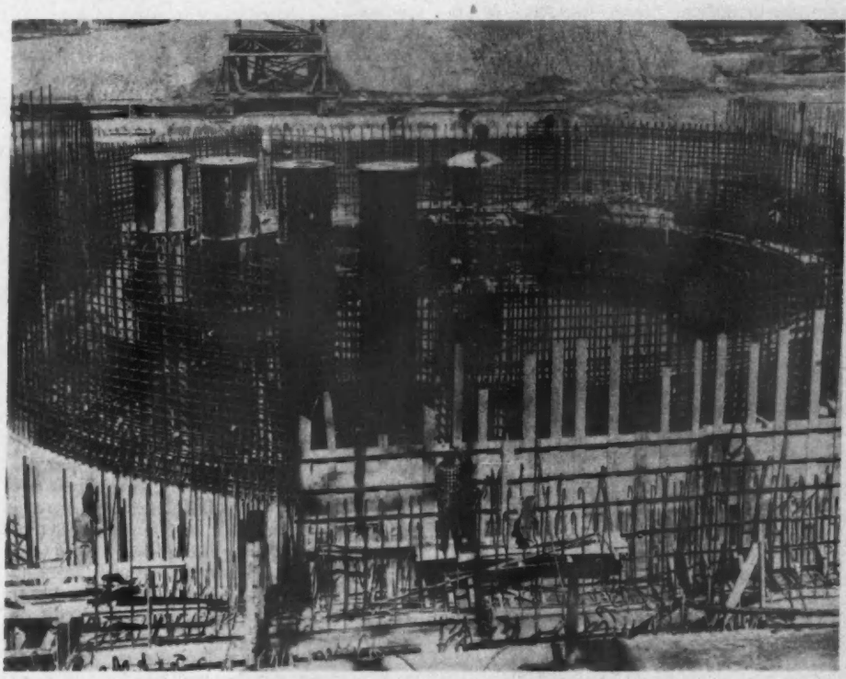
On the question of fuel for the nuclear power programme, much has been said in public and in writing about the uncertainty of fuel element life. On this subject, comparisons are extremely difficult to draw as the life of a fuel element must take into account temperature and irradiation dosage, but it is significant that failures in the Calder Hall and Chapelcross fuel elements are still less than 0·1 per cent. However, the Atomic Energy Authority has given and is still giving very close attention to the manufacture and reliability of fuel elements for the first civil reactors, and, in addition, is devoting considerable metallurgical effort to the development of fuel and canning materials for the more advanced reactors. Until nuclear power stations have been in operation for some time, the full facts will not be known, but information from Calder and Chapelcross

on fuel element behaviour is still of the utmost importance in guiding the designers, production engineers, and fuel element inspectors.

The strength of the nuclear power programme may be assessed from the fact that each of the subsequent reactors at Calder Hall and Chapelcross have not only gone critical, but have been brought up to power and have exported electricity smoothly, without incident, and on programme.

Building British Reactors Abroad

Since the Italian State-controlled concern AGIP Nucleare, a subsidiary of Ente Nazionale Idrocarburi, issued their letter of intent to the Nuclear Power Plant Company, work has gone ahead steadily on the building of the 200MW reactor at Latina, about 35 km south of Rome. Design collaboration between AGIP Nucleare, the Nuclear Power Plant Company, Ltd., and the Atomic Energy Authority who act as consultants to the purchasers, has gone along steadily during the year. The biological shield (illustrated here) has now reached about 60ft above ground level and the pressure vessel is being fabricated on site from groups of plates preformed and welded together in the United Kingdom. The heat exchangers for this plant are being manufactured in Italy by the firm Nuovo Pignone of Massa under the direction of the Nuclear Power Plant Company.



Latina nuclear power station. Biological shield reinforcement and coffin tubes

Experience on this reactor has already shown that work can be carried out abroad to British designs with the same technical content as in the U.K., and within the framework of a similar programme, which looks well for the export and construction of British designed reactors overseas.

As has been mentioned previously, the Japanese Atomic Power Company has a similar arrangement with The General Electric Company–Simon Carves Atomic Energy Group, and questions relating to the G.E.C. design have been under active consideration by J.A.P. Co. and the Atomic Energy Authority during the year.

The Japanese Press stated on November 11 that the Safety Committee of the Japanese Atomic Energy Commission had reported that they were fully satisfied with the safety of the British reactor under emergency and earthquake conditions. It is now hoped that the signing of the contract will enable work to progress rapidly, but in the meantime British teams from both the General Electric Company and the Atomic Energy Authority have visited "JAPCO" and had consultations in Tokyo.

A technical assistance agreement has already been signed between the United Kingdom Atomic Energy Authority and the Japan Atomic Power Company, and a letter of intent has been exchanged on the supply of fuel for the Tokai-Mura nuclear power station.

In both these projects, and in other tentative proposals for overseas reactors, advice has been given by the Atomic Energy Authority on the questions of reactor siting and safety, in addition to technical advice on design and construction.

Changes in the Atomic Energy Authority

An event of great significance in the field of atomic energy is the fact that Lord Plowden, K.C.B., K.B.E., relinquished the appointment of chairman of the United Kingdom Atomic Energy Authority at the end of 1959 and was succeeded by Sir Roger Makins, G.C.M.G., K.C.B., formerly Joint Permanent Secretary to the Treasury. Sir Edwin Plowden was designated as the first chairman when the intention to set up the Atomic Energy Authority was announced in October, 1953, but the Authority actually came into being on August 1, 1954. In October, 1958, the Prime Minister reappointed Sir Edwin as chairman for a further period ending on December 31, 1959. Sir Edwin, who was appointed a Life Peer at the beginning of the year, leaves to become chairman of the British Aluminium Company and vice-chairman of Tube Investments, Ltd., from the beginning of 1960.

Following the transfer of Sir William Penney to be Member of Research in place of Sir John Cockcroft who has left to become the Master of Churchill College, Cambridge, the Atomic Energy Authority has appointed Air Chief Marshal Sir Claude Pelley, G.B.E., K.C.B., M.C., as Member (Designate) for Weapons.

Another change of considerable importance in the organisation of the Atomic Energy Authority became effective on July 1, when the Authority's Industrial Group was divided into two parts—the Development and Engineering Group, and the Production Group, both of which have their headquarters at Risley in Lancashire. On the same date, Sir William Cook, with the title of Member for Development and Engineering, became executive head of the Development and Engineering Group, and, in addition, retained corresponding functional responsibilities throughout the Authority. Similarly, Sir Leonard Owen has the title of Member for Production (Designate) and became the executive head of the Production Group.

The Development and Engineering Group became responsible for the development, design and construction of reactors and their associated plants (with the exception of certain development work which will continue to be undertaken by the Research Group), engineering consultant work for the electricity boards, overseas organisations and the consortia, together with general engineering design and construction of all major building projects. In addition to the headquarters staff at Risley, the Group will control the Dounreay Experimental Reactor Establishment, Caithness, the Culcheth Laboratories and the Research and Development organisations at Capenhurst, Windscale and Springfields.

The Production Group became responsible for the operation of the Authority's factories, including the Calder Hall and Chapelcross reactors, together with Research and Development in aid of factory processes. In addition to the Group Headquarters at Risley the factories include Capenhurst, Springfields, Windscale, Calder and Chapelcross.

All commercial activities concerned with consultancy and collaborative agreements, licences and patents remain within the Industrial Power Branch of the Development and Engineering Group, whereas commercial activities regarding the sale of fuel elements, graphite, and other special nuclear materials fall within the Production Group.

Another event of considerable significance to reactor operators and other inspection organisations, as well as to members of the Authority's establishments, is the revised form of health and safety organisation which has been introduced by the Authority. A new Health and Safety Branch was established within the Authority under Dr. A. S. McLean, the Director of Health and Safety, a concept which was endorsed by the Fleck Committee early in 1958. Separate health and safety organisations in each Group Headquarters are eliminated and the new Health and Safety Branch is established as part of the headquarters organisation of the Authority. It will collaborate with, and have the assistance of, the health and safety staffs in the Authority's establishments and will have three main functions: first, to advise the Authority on the formulation of the health and safety policy and to disseminate this policy; secondly, to apply this policy to the assessment and inspection of reactors and plants (including laboratories); and, thirdly, to provide the focal point from which the Authority's external relations (both technical and political) in the health and safety field will be conducted.

Two divisions are, therefore, being set up:

first, a safeguards division at Risley, concerned with the safety of reactors, ancillary plant and laboratories; and, secondly, a radiological protection division at Harwell, concerned with the aspects of the health and safety of Authority employees and neighbouring populations. The latter division will advise the safeguards division on the standards of human protection to be applied in the evaluation of the safety of nuclear installations.

Licensing and Insurance

Following the passing of the Nuclear Installations (Licensing and Insurance) Act, Maj.-Gen. S. A. Joslin, C.B., C.B.E., who was previously with the Atomic Energy Authority, was appointed Chief Inspector at the Ministry of Power. Maj.-Gen. Joslin and his staff will be responsible for the licensing of all reactor installations in England and Wales, and will act in an advisory capacity to the Secretary of State for Scotland in this field. For the time being, Maj.-Gen. Joslin will be advised on matters of safety and radiological protection by the Health and Safety Division of the Atomic Energy Authority.

Consequently, by licensing, the Ministry will, in the interests of safety, control the building and operation of nuclear reactors and other fixed nuclear installations as may be prescribed, and will impose on any user granted a licence an absolute liability for all damage to persons or property caused by radiation arising from the site, even though this may be due to an accident. Similarly, the Ministry will insist on an obligation to take out insurance cover.

Meantime, the British insurance companies have continued their studies associated with the problem of risk attendant upon the operation of nuclear reactors and are apparently quite prepared to provide the necessary cover for liability up to £5,000,000 in respect of any one occurrence on any one site. Liability in the event of an individual accident is not, however, expected to reach anything like the figure of £5,000,000.

While the design and development of nuclear reactors is a rapidly developing field, the Ministry's staff will continue to have the assistance of the specialists within the Atomic Energy Authority. The drafting of regulations will depend not only on the training of staff to form the Ministry's team, but also on the development of reactor codes of practice and operational techniques.

As operational experience can only be gained within the Atomic Energy Authority for the next year or two, the Ministry staff will inevitably be in close contact with the appropriate divisions of the Atomic Energy Authority on all questions regarding the precautions to be taken in design and operation to ensure safety and achieve adequate radiological protection, both to the workers on any nuclear plant and to the population in the immediate vicinity.

Safety

Following the recommendations made by one of Sir Alexander Fleck's committees set up after the accident to one of the Authority's reactors at Windscale, a committee on the training of personnel in health and safety was set up under the chairmanship of Sir Douglas Veale.

The committee has made two interim reports, and the final report is now due. The first interim reports recommended special post-graduate courses at the universities to train graduates in science or medicine to undertake specialist posts in the field of radiological health and safety, and the second report recommended a summer school for people who, although not engaged on full-time health and safety duties, need some knowledge of the problems involved.

It is interesting to note that one of the three original Committees under the chairmanship of Sir Alexander Fleck commented particularly on the shortage of highly-qualified people needed to deal with radiation hazards and the excessive burden placed on the now available experts, and recommended that the Atomic Energy Authority should take the lead in building up a supply of such experts and should also consider what training was required to meet the needs of the nation.

With this background, the Authority set up the Veale Committee, but the problem is a complex one. The committee has to consider a wide variety of people ranging from health physicists and district nurses to senior scientists in nuclear power stations. Much fundamental thinking will be required from Government departments, industry, hospitals and universities, for this subject is both new and rapidly developing. The Authority intends to publish the final report of this committee after consultation with the appropriate Government departments.

Design and Development by the Industrial Consortia

While it is the consortia who have to make the main design contribution to the advancement of gas-cooled reactors using the present type of fuel element, it should be considered along what lines this contribution must be made if the prospects for the generation of electricity at an economic price in this country are to be improved and if the U.K. is to receive orders for a larger number of British reactors for construction abroad.

First, the reduction in capital cost per kilowatt installed must be seriously tackled and there are several ways in which this may progress.

1. It is important that the design of the reactors and the ancillary plant be optimised fully for the required output, within the framework of the Electricity Board's specification.

2. It is important that, to achieve the required output, more power is obtained from a given physical size of core by using higher fuel ratings. This, however, needs the extraction of more heat from a given surface area, therefore requiring careful consideration of the operating pressure in the gas circuit if an unduly high percentage of the gross generated power is not to be wasted in driving the cooling gas blowers.

3. Alternatives and improvements in design in the general engineering and layout of the plant must be considered so as to effect economies in capital cost for a given size of reactor vessel.

4. Alternative types of fuel element may be considered, provided that they do not employ an unduly high enrichment of the uranium which would tend to offset the other economies in the plant.

Several of these considerations are dependent upon the solution of quite severe metallurgical problems, but this is one field in which strides are being made.

Not only is the design and development work on advanced reactors being discussed between the consortia and the Atomic Energy Authority, but a continual exchange of views takes place between the consortia and the Authority on design and development factors affecting the present magnox type gas-cooled reactors. Consequently, the consortia, while pressing ahead with the development and re-optimisation of design on present-day reactors have work in hand in aid of advanced gas-cooled reactor systems, both of which may show considerable improvements in capital costs, thermal efficiency, and economic operation.

Bearing in mind the manpower which is required to develop a reactor system to the stage where a nuclear power station can be built (on which Sir Edwin Plowden gave some figures when addressing the Federation of British Industries Conference at Eastbourne in 1958), it is obvious that the consortia cannot undertake the development of several reactor systems simultaneously. Having invested considerable research and development effort in the original magnox fuelled gas-cooled reactor systems they will obviously develop them step by step to give progressively better results, and at the same time could quite well undertake the initial development in aid of design for the next most likely reactor system.

Considering that some of the consortia have already put forward proposals in the marine reactor field, one has to appreciate the diversity of effort which is required from the reactor design teams and the supporting development personnel in each consortia to progress in these diverse reactor fields simultaneously.

As the Atomic Energy Authority will produce the fuel elements for the civil stations, both they and the consortia have undertaken and are still undertaking considerable development work on fuel element design and manufacture. Again, this is a collaborative effort until each individual design is "finalised" and "specified," when it is in the hands of the Atomic Energy Authority to ensure the best possible manufacturing techniques.

The consortia themselves are constantly seeking improved heat transfer performance from these fuel elements, and this effort may lead to gradual changes in fuel element can design, quite apart from different kinds of fuel element which move away from the present designs having a single metallic uranium bar housed in a magnox or magnesium alloy can. Metallurgical work is constantly being done, not only on the pre-treatment of uranium but also on the effects of irradiation, together with careful studies on the metallurgical properties of various canning alloys and their behaviour under irradiation at operating temperatures.

Later this year, the first two reactors at Bradwell and Berkeley will be reaching completion and the start-up and commissioning procedure will begin. These will be important events in the British nuclear power programme: they will be the beginning of an interesting period when commissioning and operational experience on the larger reactors will start to feed back to the designers valuable data which can be used in the closer optimisation of reactor performance, on improvements in design affecting simplicity of operation and as detailed information affecting fabrication techniques and the methods of construction, all of which will go subsequently towards lower capital cost and consequently lower cost per unit generated.

In conclusion, it may be said that the past year has been one of consolidation in reactor techniques for large-scale reactors, from which benefits may accrue as early as the next round of nuclear stations, but, in addition, considerable activity has continued in the field of alternative reactor systems and nuclear engineering generally on an increasingly international scale which, together with the start-up of the world's first large fast fission reactor, may prove 1959 to be a historical year in the field of nuclear engineering.

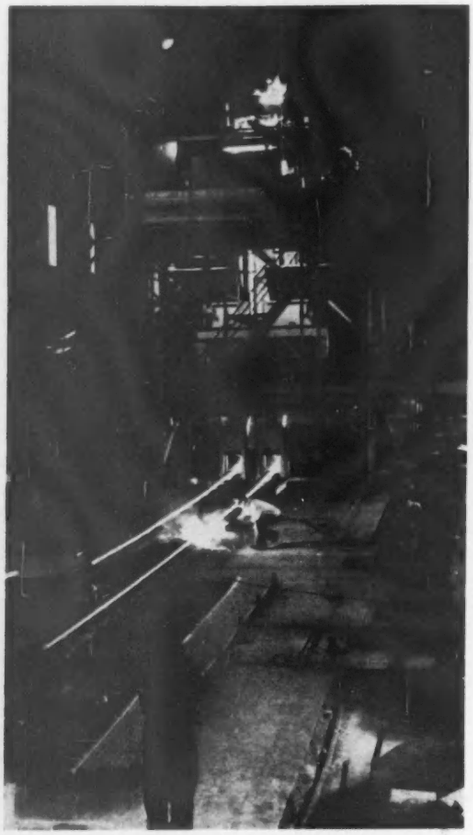
1959

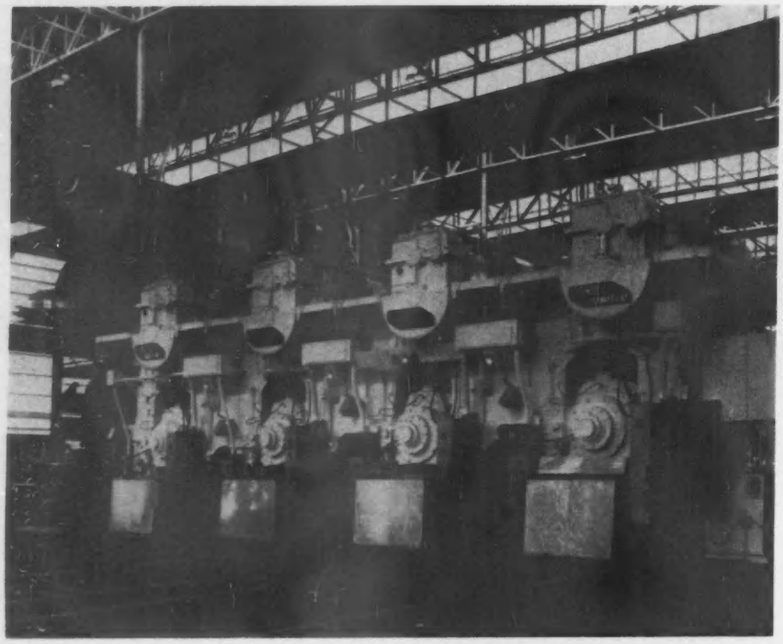
It is characteristic of engineering inventions and devices that development tends to follow an evolutionary course; novelty and originality are a matter of degree, and only in exceptional cases is a complete break made from what has gone before. Nevertheless the pace of progress is so great that in reviewing a comparatively short period, it is still possible to pick out quite an impressive record of achievement. The pictorial review of the year 1959, which is given in the following pages of this supplement and will be continued in our next issue, shows some of the more important or novel achievements of the past twelve months. The emphasis is largely on the work of British engineers, but some examples are given of engineering developments on the Continent and in the United States. The descriptions given are brief, and should appeal to all engineers, regardless of their individual specialisation, for in quite a number of cases full technical facts were published in this journal at some time last year, when the particular subject concerned was topical Other matters, particularly those not amenable to pictorial treatment, are discussed in accompanying articles. In contrast with the general trend just discussed, our first illustration depicts one of the most dramatic developments of the year, namely, the successful completion and use of an experimental craft of a very novel kind.

The "Hovercraft" stemmed from attempts to reduce the skin friction of displacement craft by using an air bearing, but the vehicle now in being can negotiate any unbroken surface, liquid or solid. It floats on a cushion of air under slight pressure, the cushion being defined and maintained by a curtain formed by a jet sheet; the sheet issues from a slot slanted towards the centre of the planform, so as to increase the change in momentum involved in deflecting the jet outward. The principle is very much the same as that of the jet flap. Not one but a series of curtains is used, so that the pressure increases over any part of the planform which is closer to the ground. The craft is propelled by jets of air, although airscrews could well be used, and steered by vanes in the jets; those at the rear are extended upwards to give static directional stability at speed. The two-seater experimental vehicle illustrated crossed the English channel on the fiftieth anniversary of the first crossing by an aerodyne; it is powered by an Alvis "Leonides" helicopter engine driving a single-stage ducted fan. Since the energy dissipation in the jet sheet rises less fast than the area of the cushion as linear scale is increased, large vehicles are expected to be economic as well as convenient, and it is foreseen that such craft will have applications over frozen lakes and rivers, in undeveloped territories and on boggy going. The inventor of the "Hovercraft" is Mr. C. S. Cockerell; it was built by Saunders-Roe Ltd., and is known as the SR-N1.

Iron and Steel

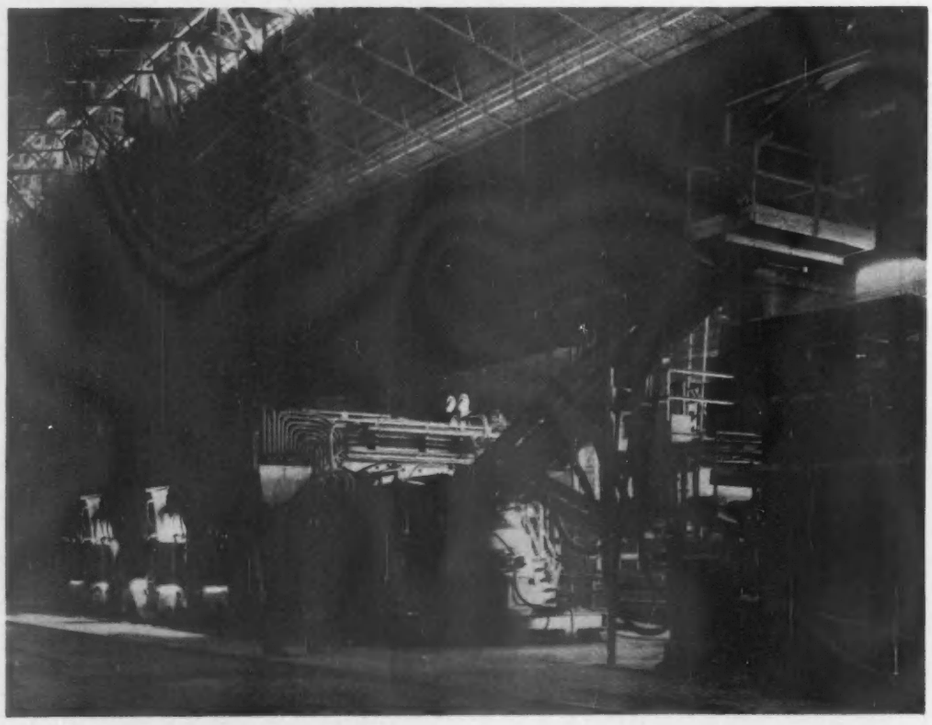
At the beginning of last year, The United Steel Companies, Ltd., announced the successful completion of a long period of experimental and development work at the Barrow Steel Works, on the continuous casting process. It has since been stated that there is being installed at Barrow a 20-ton electric furnace and two continuous casting machines which are expected to provide 36,000 tons of billets a year. Casting steel in continuous lengths avoids the intermediate ingot stage. The twin-strand continuous casting machine illustrated RIGHT is that installed experimentally at Barrow. It casts small billets, mainly 2in square, at a rate of 220–360 in a minute which, it is claimed, is from two to three times faster than with any other known plant. The operation of the plant is automatically controlled.

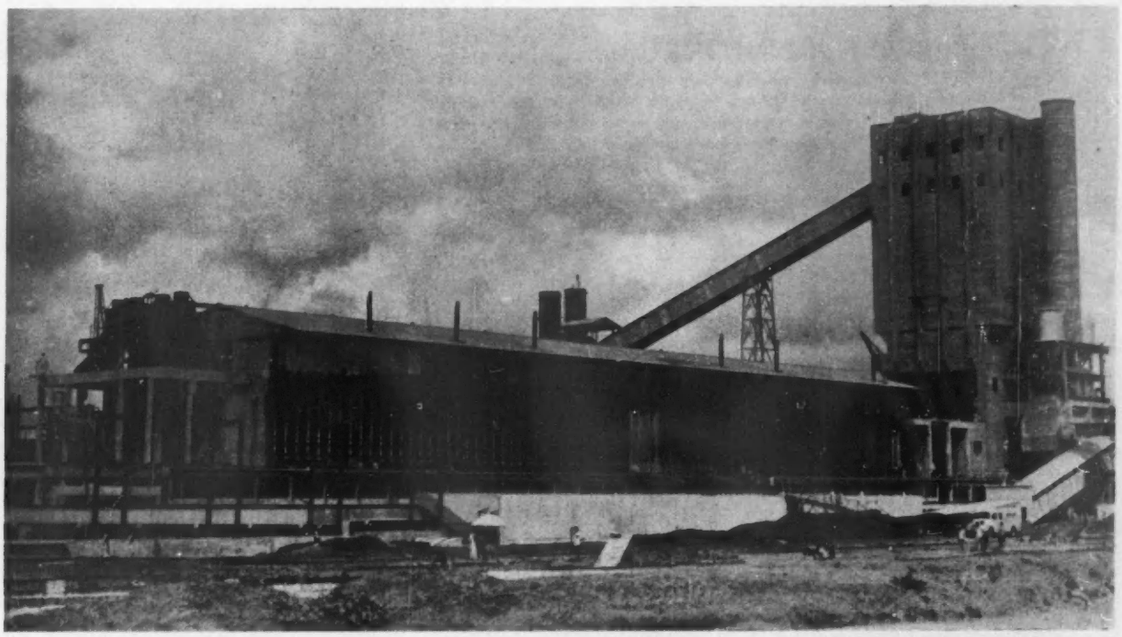




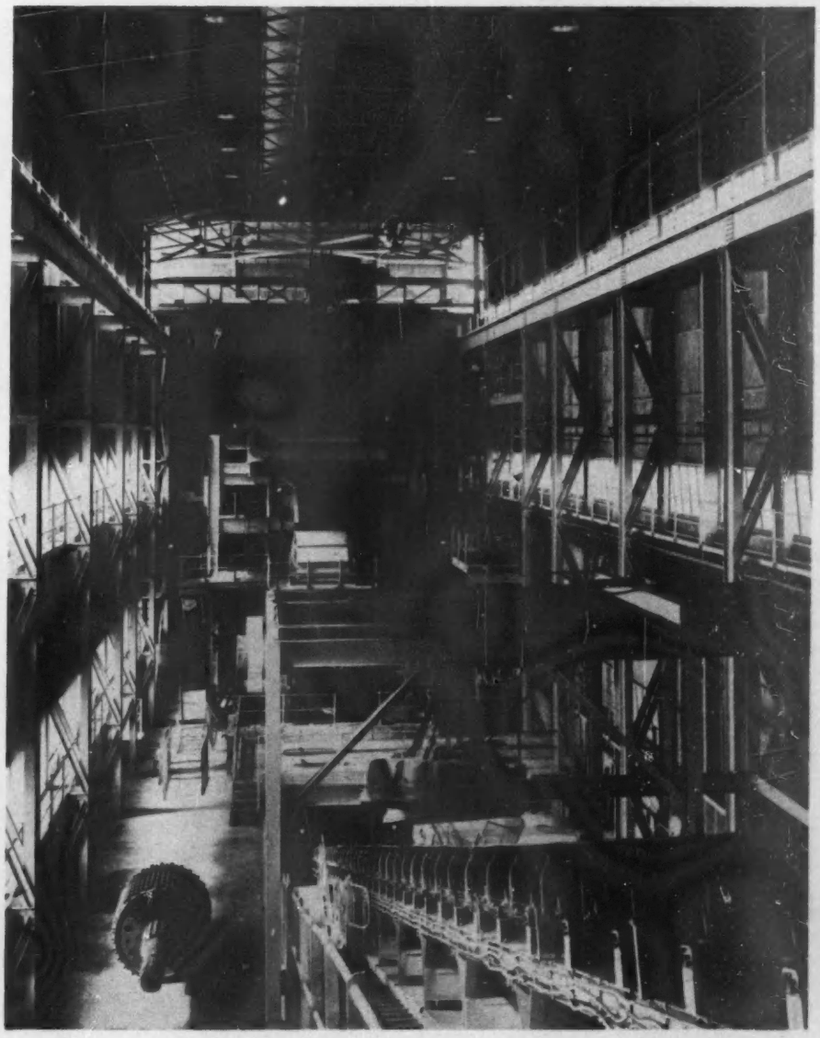
At the Abbey Works of The Steel Company of Wales, Ltd., a new four-stand cold reduction mill went into operation during the year. This mill, LEFT, rolls steel strip for processing into thin sheets. There are 21in diameter work rolls and 53in diameter back-up rolls, all of which are 56in long on the barrel, the strip handled being up to 50in wide. Strip thickness normally varies from 0·120in to 0·076in on entering the mill and from 0·035in to 0·012in on the outgoing side. Coils up to 56,000 lb in weight are rolled at speeds of up to 3500ft a minute.

The second open hearth furnace at the works of Appleby-Frodingham Steel Company to be converted to the "Ajax" oxygen process was started up in June. The furnace, RIGHT, retains its original hearth area of 526 square feet and is tapping an average of 180 tons from charges consisting of 100 per cent phosphoric pig iron produced entirely from home ores. The combined output of the two furnaces at Appleby - Frodingham now converted to the "Ajax" process is around 9000 ingot tons of steel a week, the average fuel consumption being under 10 therms a ton.





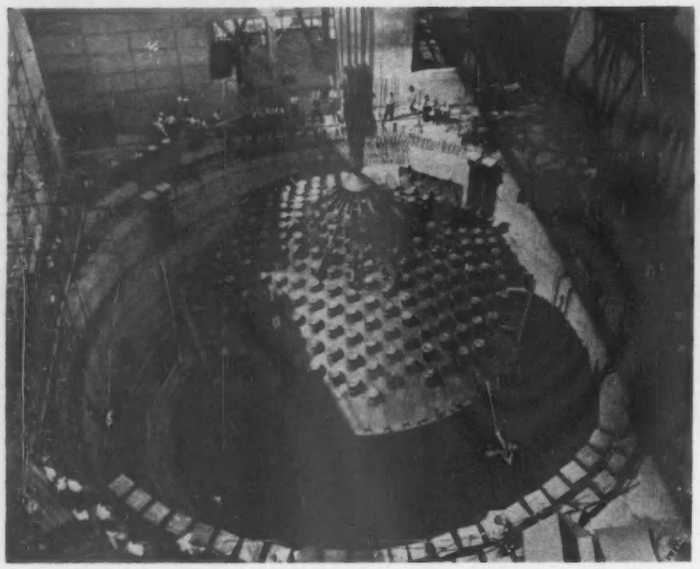
This country is an exporter of iron and steel works plant and equipment, a notable example being the building of the Durgapur works in India. This plant, which is designed for an initial capacity of 360,000 tons of pig iron and 1,000,000 ingot tons of steel a year, is being constructed by a consortium of British firms entitled Indian Steelworks Construction Company, Ltd. During the past year the first stage was completed. It includes the No. 1 coke oven battery, illustrated ABOVE, which was built by Simon-Carves, Ltd., and formally lit on August 24. The No. 1 blast-furnace was also finished last year. When the project is completed in April, 1961, there will be three batteries of coke ovens and three blast-furnaces. The melting shop is being equipped with seven open-hearth furnaces.

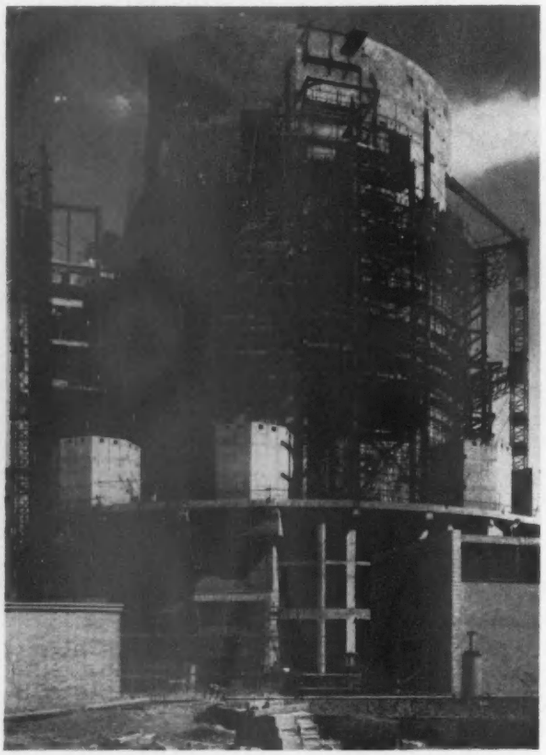


At the beginning of October, Stanton Ironworks Company, Ltd., opened a new ore preparation plant which has been built, at a cost of nearly £4,000,000, at its Ilkeston works. The plant, which occupies a site of approximately 40 acres, is designed to process between 25,000 and 30,000 tons of ore a week, the aim being to increase blast-furnace efficiency and to enable the use of home ore reserves. The illustration RIGHT shows the crusher house, with the primary crusher in the background and the conveyor to the secondary crushers.

Nuclear Power Stations

Progress in three of the nuclear power stations for electricity supply in Great Britain is illustrated here. The picture BELOW, LEFT, shows the dome of the pressure vessel of No. 2 reactor at Bradwell being lowered into position. This 300MW C.E.G.B. station is due to be completed in 1961.



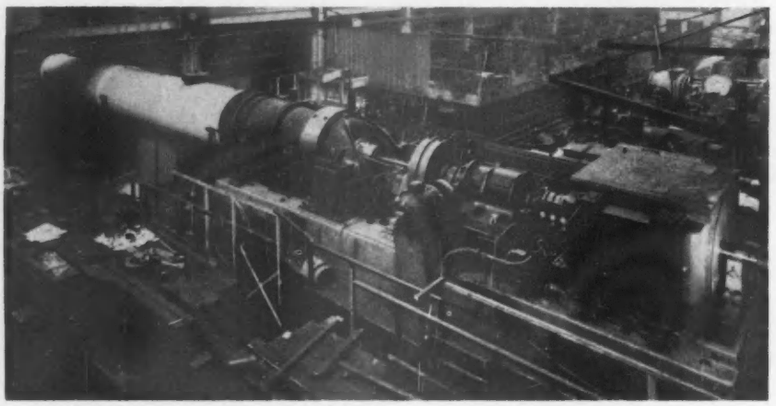


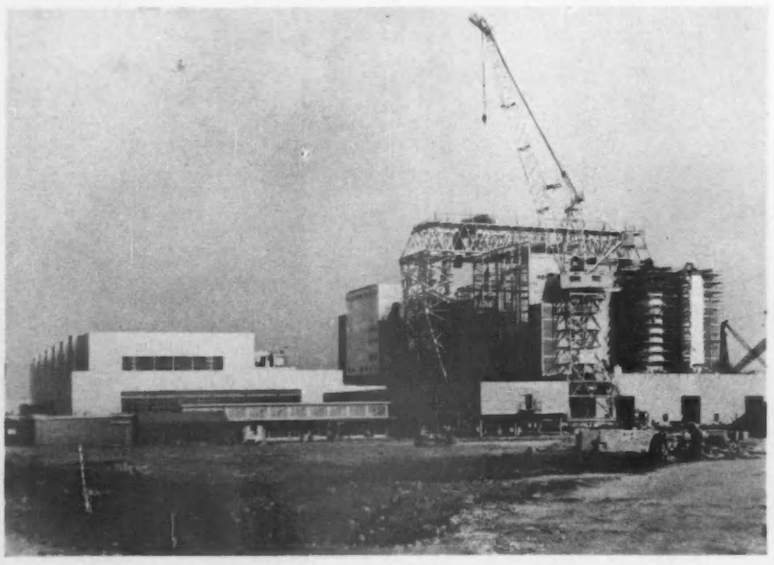
The state of progress at Bradwell, Essex, was described in our issue of October 30. Our illustration (BOTTOM, RIGHT) gives a general view of the two reactors. The main contractor is the Nuclear Power Plant Company, Ltd.

At Hunterston, in Ayrshire, where the G.E.C.-Simon-Carves consortium is building a 300MW station for the South of Scotland Electricity Board, progress has been retarded, first by delays at the court of inquiry and, more recently, by labour disputes. A recent photograph of the first reactor is reproduced TOP RIGHT.

Berkeley power station, Gloucestershire (275MW), which is being built for the C.E.G.B. by the A.E.I.-John Thompson Nuclear Energy Company, Ltd., is scheduled for completion in 1961 and the rate of progress is generally level with that at Bradwell power station. Auxiliary plant and machinery are being installed according to programme. The illustration, CENTRE, RIGHT, shows one of the sixteen gas circulators for Berkeley undergoing tests at the B.T.H. Rugby works. Each circulator consists of an axial-flow compressor driven through a variable speed coupling by a 4000 h.p., 2980 r.p.m. a.c. motor.

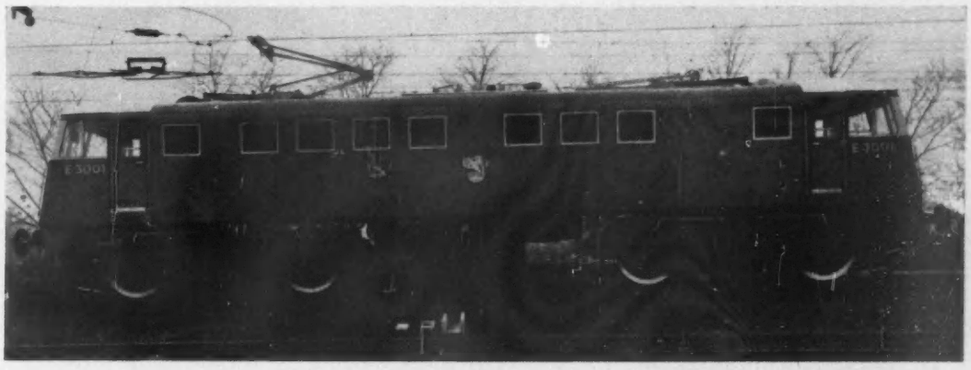
On Plate 14 there is an illustration showing the Goliath crane and one of the reactors at the 500MW Hinkley Point power station which is being built for the C.E.G.B. by the English Electric, Babcock and Wilcox, Taylor Woodrow Atomic Power Construction Company, Ltd. It is due to be completed in 1962.



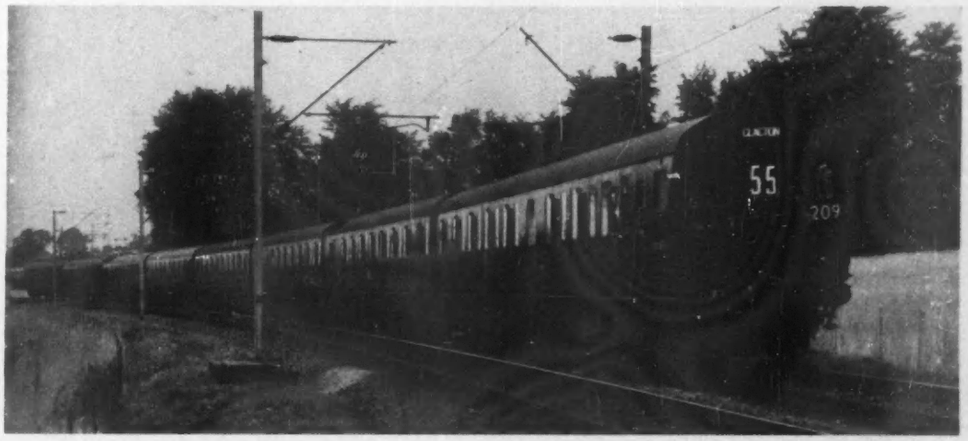


A.C. Traction

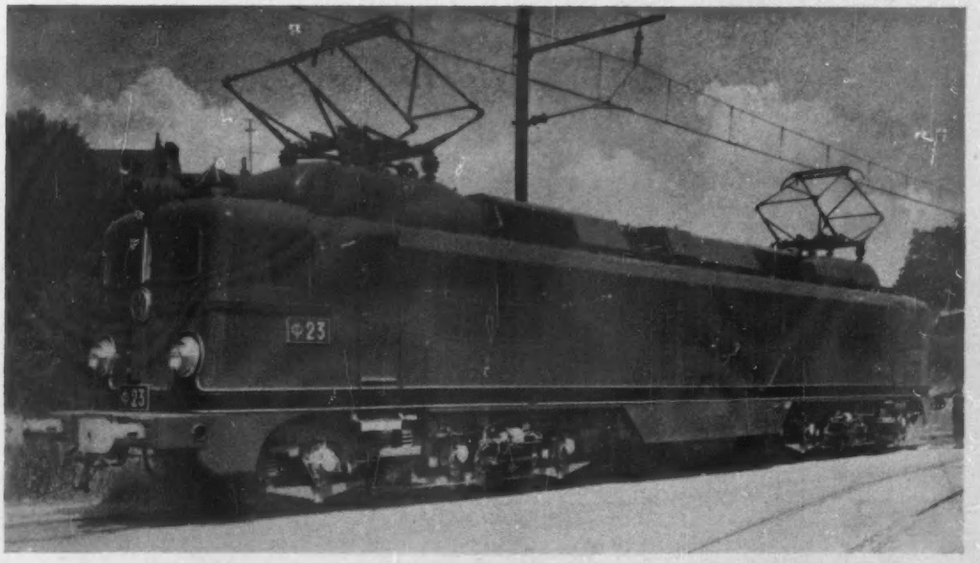
The first of the main-line a.c. locomotives for the British Railways high-voltage 50 c/s electrification scheme was handed over to the London Midland Region in November by Associated Electrical Industries, Ltd. Twenty-five locomotives of the design illustrated are being supplied by A.E.I. Mechanical parts are being built under a sub-contract by the Birmingham Railway Carriage and Wagon Company, Ltd. This 3300 h.p. B_o–B_o locomotive weighs 80 tons and is equipped for automatic changeover at speed between the two voltages (6·25kV and 25kV) characteristic of the British Railways a.c. system. The traction motors are fully springborne, with flexible drives to the axles.



In April the local passenger services of the Eastern Region, British Railways, between Colchester, Clacton-on-Sea and Walton-on-Naze were converted to electric traction at 25kV, 50 c/s. This was the first commercial application of the 25kV a.c. system in Great Britain, although former d.c. trains converted for working at 6·25kV, 50 c/s have been running on the Lancaster-Morecambe-Heysham line of the London Midland Region since 1953. The Colchester-Clacton-Walton service is operated by multiple-unit sets equipped by The English Electric Company, Ltd., one of which is illustrated. These trains will be transferred eventually to the Fenchurch Street-Southend line. The control equipment, rectifiers and auxiliary machines are carried on the underframes of two coaches in each set.



The U.S.S.R. railways are electrifying a section of the Trans-Siberian line on the high-voltage 50 c/s a.c. system, and during 1959 deliveries began of fifty locomotives ordered from the French group, Materiel de Traction Electrique, comprising Alsthom, Forges et Ateliers du Creusot, Forges et Ateliers de Constructions Electriques de Jeumont, and Le Materiel Electrique Schneider-Westinghouse. One of these 5500 h.p. rectifier locomotives is illustrated. They are being built in passenger and freight versions geared respectively for top speeds of 99 m.p.h. and 62 m.p.h. Ten of the locomotives for freight traffic are equipped for regenerative braking by returning current to supply through the grid-controlled rectifiers, which then operate as inverters. Normal weight is 120 tons (138 tons with ballast).



Haringvliet Dam

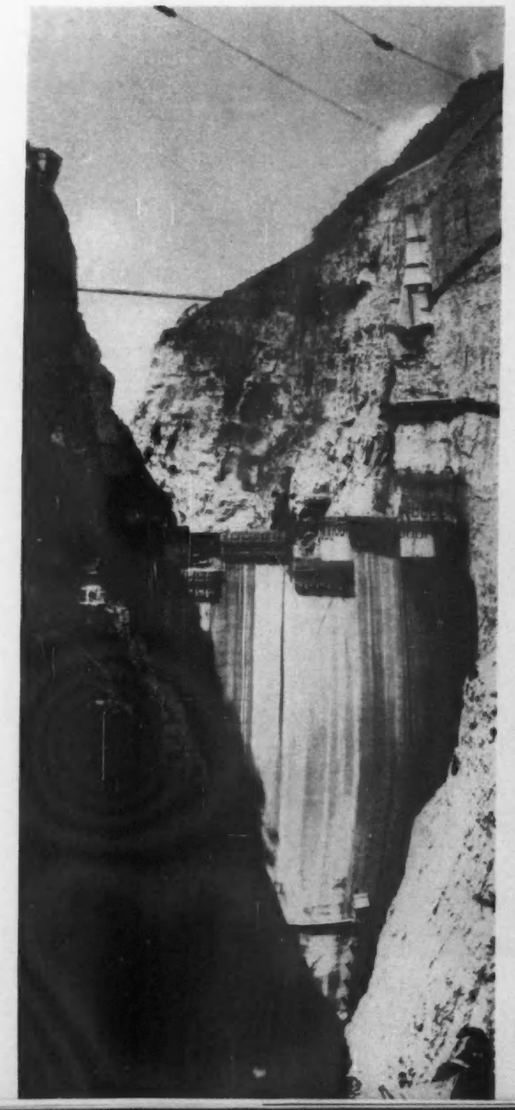
Progress last September is shown BELOW. By contrast the upper view shows progress early in 1957 when the enormous cofferdam, complete in the lower view, was just beginning to emerge from the sea bed. The dam is to be a principal structure of the Delta scheme in South Western Holland, and will close a sea arm 5km across; it will be completed by 1968. The second cofferdam in the background of the lower view is for a ship lock; behind it work on the permanent embankment has been started. To the left is a constructional harbour. Excavation for the sill structure and piers carrying the sluice gates (seventeen openings each of 56·5m) is well advanced, and the shape of the formation (drained by an elaborate well-point system) and various spoil heaps are evident. Five piling frames covering the whole width of the sluice structure, will gradually work towards the foreground, driving r.c. piles. Two further frames are in use at the "abutment" where the sluice structure will join the massive embankment of the permanent dam. Extensive steel sheet pile cut-offs are also being driven; 24,000 tonnes of steel sheet piling and 22,000 concrete piles, 8m to 24m in length, will be needed. Full description "The Engineer," October 2 last.

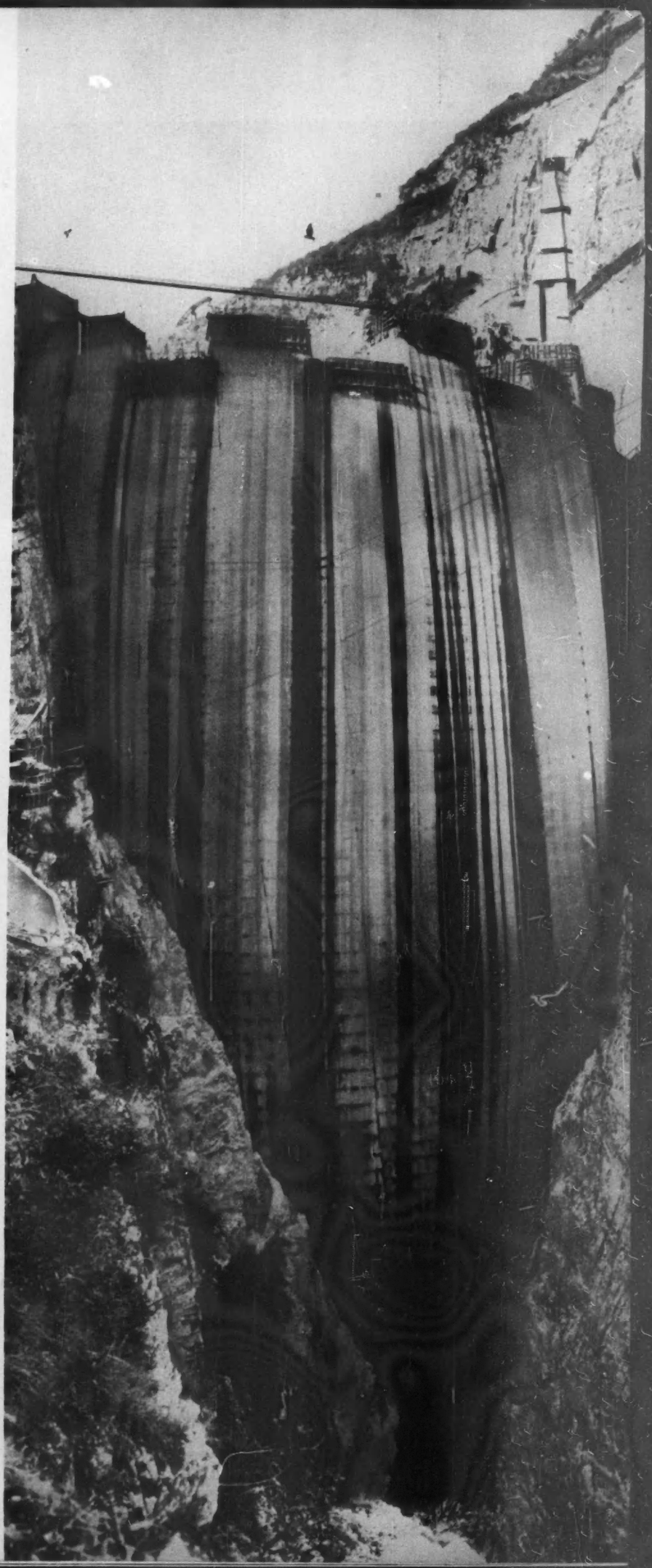
Vaiont Dam

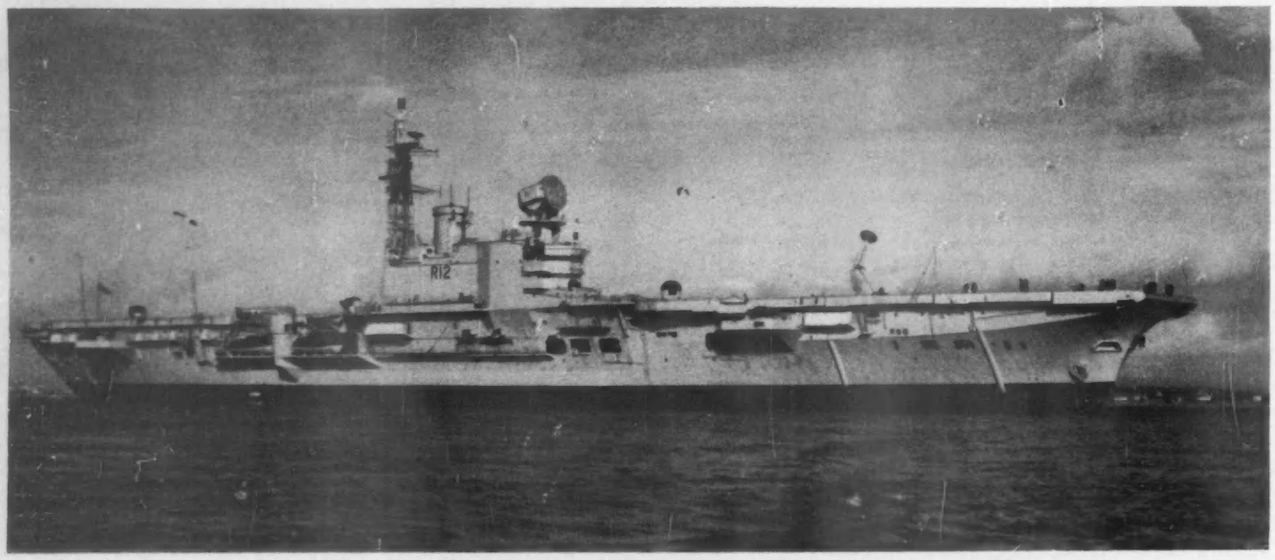
Rapid progress in the final stages of the Vaiont Dam is vividly shown in these upstream views taken (LEFT) on August 7 last and (RIGHT) on October 29. Seasonal storage of 60 × 10^6 cubic metres in the 150 × 10^6 cubic metres reservoir will provide another 150 GWh towards an ultimate 1890 GWh per annum from the middle Piave and Livenza schemes of the Societa Adriatica di Elettricita, Venice (see "The Engineer," April 3, 1953, page 482).

The principal data of the dam are: height 261·6m (exceeding the previously highest arch dam, Mauvoisin, by 25m), crest 190·5m, crest chord (including saddles) 168·6m, thickness at base of plug 22·71m, thickness at top 3·4m. Such slimness was achieved by adopting a cupola design with a high degree of symmetry, requiring extensive excavation. Between October, 1956, and May, 1958, some 390,000 cubic metres of rock were excavated, including tunnels. The main structure rests on a 50m high base plug and lateral saddles by means of a continuous peripheral joint, and in addition has three horizontal joints spaced approximately 50m apart. Concrete was placed in 2·4m lifts with vertical construction joints (grouted later) at every 12m. Concrete volume is 360,000 cubic metres.

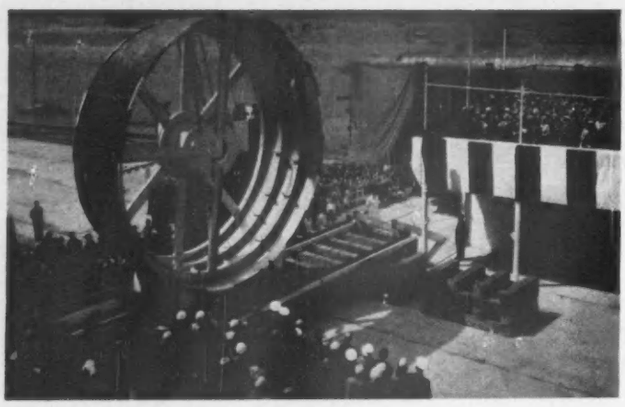
Through a gap in the construction (LEFT) may be seen the aqueduct crossing the gorge; it is this level which determines the useful capacity of the reservoir.





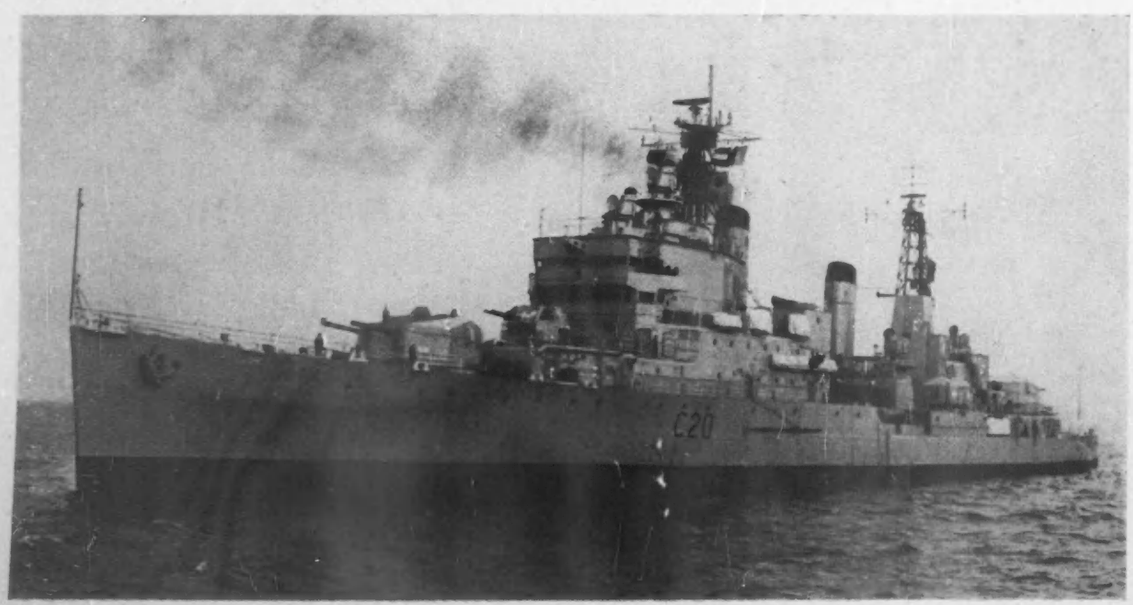


Warships Now that the battleship H.M.S. "Vanguard" has been earmarked for breaking-up, aircraft carriers become the largest fighting vessels in the Royal Navy. The latest ship of that character to join the fleet is H.M.S. "Hermes" (ABOVE). She is the fourth ship of the Centaur class, originally laid down during the war. She was launched in 1953 and has a displacement of 22,000 tons, a speed of 28 knots and a complement of forty-five aircraft. She has an angled-deck, the latest improved arrester gear and two steam-operated catapults and her radar equipment is more modern than that of her sister vessels. Though "Hermes" is smaller than our larger carriers, such as the "Eagle" and "Ark Royal" of 43,300 tons displacement, it is expected that she will prove little inferior operationally. Builders, Vickers-Armstrongs (Shipbuilders), Ltd.



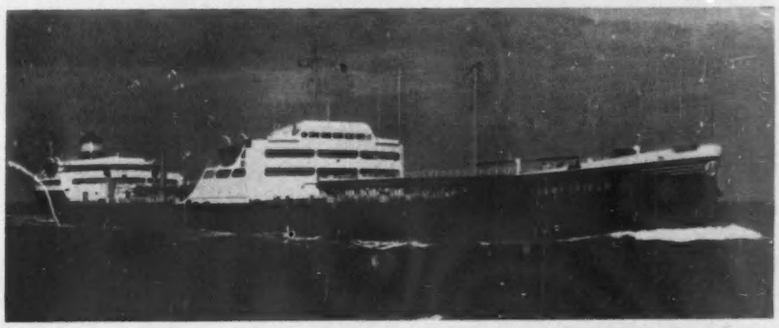
RIGHT, the Duke of Edinburgh "laying the keel" of Britain's first nuclear-powered submarine, to be named the "Dreadnought," at Vickers-Armstrongs, Barrow. This submarine will have a hull of the same shape as the U.S. submarine "Albacore." The shape is similar to that of a whale and the diving planes more conventionally placed at the bows will be transferred to the high conning tower. Nuclear propulsion plant is being built in the United States and will be similar to that installed in the U.S. submarine "Skipjack." It seems to be expected, based upon reports of the speed of "Skipjack" that, submerged, "Dreadnought" may reach a speed of 35 knots.

H.M. Cruiser "Tiger" (BELOW) joined the fleet during 1959. She is the first of three ships which were laid down in 1942 and laid up in a state of partial completion for many years, but which are now being completed with conventional gun armament. She has 3in and 6in guns capable of a very high rate of fire. The 6in guns are capable also of being directed by radar and all guns can be used in surface or anti-aircraft roles. The displacement of the "Tiger" is 9550 tons. Builders, John Brown & Co. (Clydebank), Ltd.

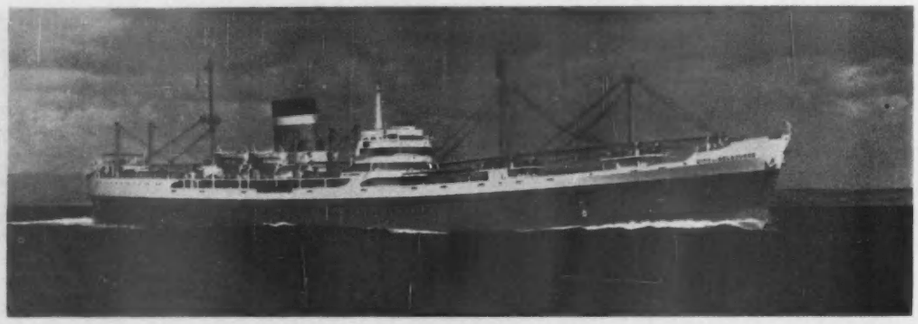


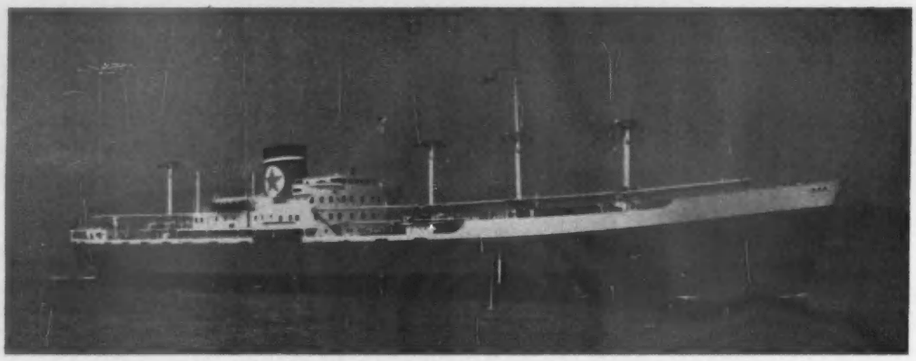
Tankers

Built for the B.P. Tanker Company, Ltd., by Harland and Wolff, Ltd., the "British Statesman" (top RIGHT), has a deadweight of 42,000 tons and measures 665ft by 95ft by 51ft. There are forty-four oil cargo tanks; machinery consists of one set of double reduction geared turbines of 16,000 service shaft horsepower and two Babcock and Wilcox boilers supplying steam at 600 lb per square inch and 850 deg. Fah. The "San Calisto" (centre RIGHT) was completed by the Furness Shipbuilding Company, Ltd., for the Eagle Tanker Company, Ltd., and carries 31,725 tons deadweight on 630ft length between perpendiculars by 87ft beam by 45ft 6in depth. One set of Metropolitan-Vickers double reduction turbines of 12,500 s.h.p. power the ship and take steam at 600 lb per square inch and 850 deg. Fah. from two Foster-Wheeler boilers. Hawthorn Leslie (Shipbuilders), Ltd., delivered the 32,000 tons deadweight "Thamesfield" (lower RIGHT) to Hunting (Eden) Tankers, Ltd. There are thirty oil cargo tanks and propulsion is by double reduction geared turbines developing 14,500 maximum shaft horsepower when supplied with steam at 600 lb per square inch and 850 deg. Fah. The Shell tanker "Varicella" (BELOW) was built by Swan Hunter and Wigham Richardson, Ltd., at Wallsend and measures 640ft by 85ft by 46ft 7in and carries 33,250 tons deadweight. Four 1160 tons per hour Drysdale pumps handle the cargo oil. Two Babcock and Wilcox boilers supply steam at 600 lb per square inch and 900 deg. Fah. to Wallsend Slipway geared turbines of 11,000 service shaft horsepower.



Cargo Ships



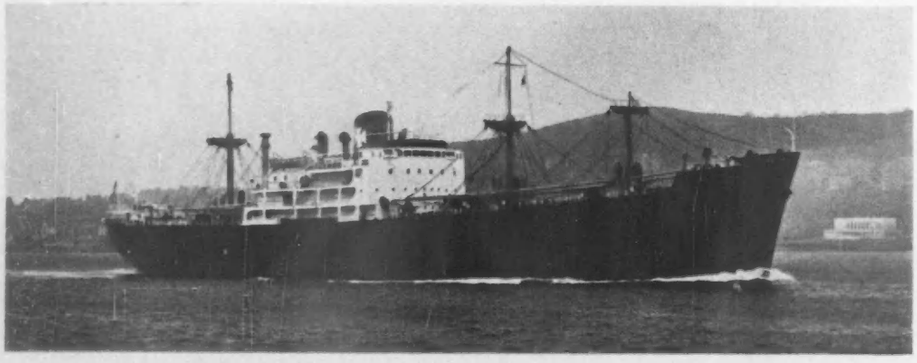


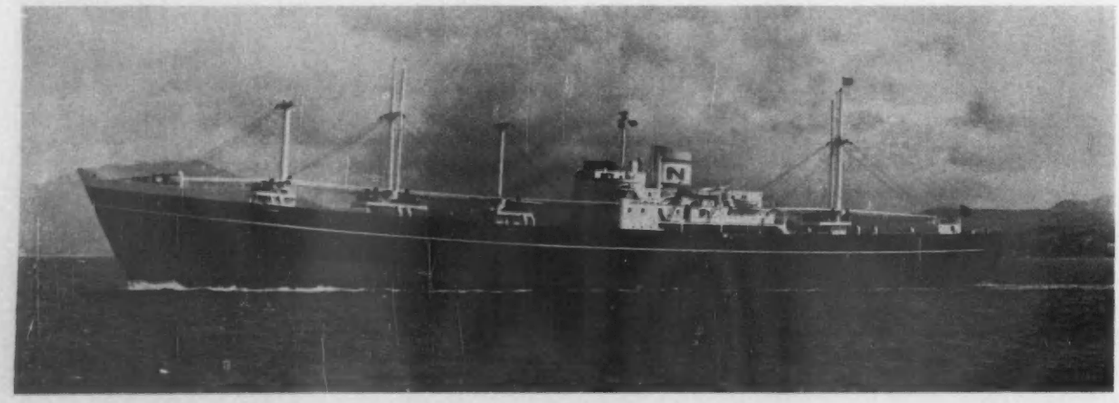
The general and refrigerated 12,300 tons deadweight cargo liner "City of Melbourne" (RIGHT) was built by Alexander Stephen and Sons, Ltd., for Ellerman Lines, Ltd. Her main dimensions are: length between perpendiculars 510ft, breadth 71ft, depth to second deck 33ft 6in. There are five holds, one 20-ton, eight 10-ton, four 7-ton and six 5-ton derricks served by electric winches. Four 320kW Allen generators provide electrical power and a service speed of 17 knots is maintained by a twelve-cylinder Stephen - Sulzer engine developing 14,000 b.h.p. at 114·5 r.p.m.

Harland and Wolff, Ltd., built and engined the "Ulster Star" (ABOVE) for the Blue Star Line, Ltd., and the ship has the following dimensions: length between perpendiculars 490ft, breadth moulded 70ft, depth to upper deck 38ft 3in, gross tonnage 10,500. Six passengers are accommodated and there are two complete decks and six holds, four forward and two aft of the machinery space, fitted with Macgregor hatch covers. The cargo is handled by two 10-ton, six 5-ton and twelve 3-ton derricks controlled by twenty 3-ton electric winches. Electrical power is developed by four 400kW generators each driven by a six-cylinder diesel engine. Propulsion is by a Harland and Wolff opposed piston, single-acting, two-stroke oil engine having six cylinders of 750mm bore by 2000mm combined stroke.

The British Empire Steam Navigation Company, Ltd., took delivery of the "Swan River" (below LEFT) from the Greenock Dockyard Company, Ltd., and the ship carries a deadweight of 12,900 tons on a draught of 29ft 5in and a length between perpendiculars of 456ft by 63ft 6in beam by 39ft 4½in depth to upper deck. There are five cargo holds served by six 12½-ton, eight 5-ton and two 2-ton derricks operated by sixteen electric winches, there being provision for fitting a 50-ton and also a 25-ton derrick. Three 180kW generators are each driven by a Mirrlees diesel engine. A Hawthorn-Doxford opposed piston oil engine of five cylinders of 670mm bore by 2320mm stroke and developing 5500 b.h.p. at 115 r.p.m., gives a service speed of 13½ knots.

BELOW is the "Lord Gladstone" built by Scotts Shipbuilding and Engineering Company, Ltd. The main particulars are: 488ft length between perpendiculars, 67ft 3in breadth, 42ft 3in depth and deadweight 15,552 tons. One 35-ton, one 20-ton and twelve 5-ton derricks serve the six holds. A Scott-Doxford supercharged oil engine of 9000 b.h.p. gives a service speed of 15 knots.





Great Ouse Flood Protection Scheme

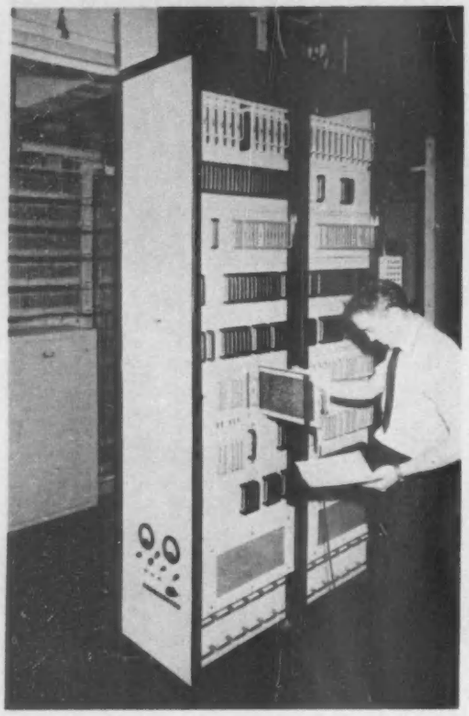
The first part of the Great Ouse flood protection scheme, the flood relief channel, 11 miles long, from Denver to King's Lynn, was completed in 1959 and formally opened by H.R.H. the Duke of Edinburgh, K.G., on October 23 last. Total excavation was about 11,000,000 cubic yards, and the channel is crossed by five reinforced concrete road bridges, each of five spans, and by Magdalen railway bridge, a five-span steel structure. The head sluice at Denver has three steel lifting gates 30ft wide by 22ft deep, and the tail sluice near King's Lynn shown ABOVE has seven lifting gates, 30ft wide by 22ft deep, and seven automatic flap gates for similar openings. Raising and strengthening the tidal river banks to give a freeboard of 3ft over the 1953 surge level was also undertaken. Consultants, Sir M. MacDonald and Partners ; contractor, Sir Robert McAlpine and Sons, Ltd.

Stage II comprises the widening and deepening of the Ely, Ouse and Ten Mile rivers over a length of 19 miles and the setting back of the banks where widening is necessary. This latter involves the construction of several miles of new road at the back of the banks. In addition, there are two new reinforced concrete road bridges and the protection to the foundations of all the bridges over the river. This is due to be completed at the end of 1961. Stage III, the construction of 27½ miles of cut-off channel from the River Lark at Barton Mills to Denver, together with two river crossings and road and railway bridges, will start in the Spring of 1960. Stage II contractor, Derek Crouch (Contractors) Ltd.

Telecommunications

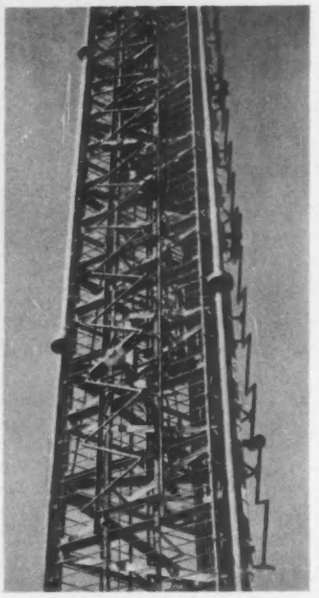
The British Post Office is conducting experiments at its Dollis Hill research station in electronic telephone exchange techniques, in conjunction with the five manufacturers forming the Joint Electronic Research Committee. Our illustration BELOW shows register equipment designed and manufactured by Siemens Edison Swan, Ltd., for receiving digits dialled by subscribers and using them to set up calls.

Microwave radio links are being used increasingly to increase the capacity of telephone systems overseas. We



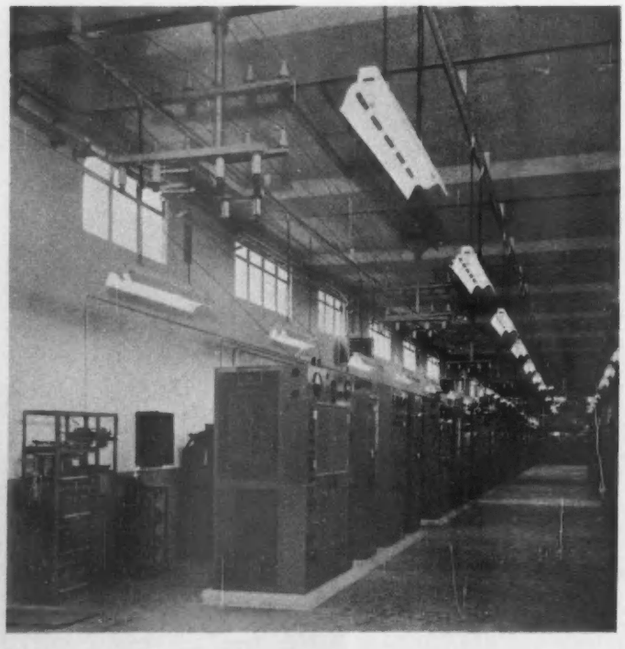
illustrate BELOW LEFT the Tampin repeater station in the trunk telephone network supplied to the Pan-Malayan Department of Telecommunications by Standard Telephones and Cables, Ltd., the first microwave system in Malaya.

During the year the Admiralty W/T Station, Inskip, Lancs, was completed. Transmitters for h.f. and l.f., BELOW RIGHT, were supplied by Marconi's Wireless Telegraph Company, Ltd., and Standard Telephones and Cables, Ltd.



We illustrate ABOVE the "Streamline 5" television transmitters designed specially by Pye, Ltd., for the Mendlesham, Norfolk, station of the Independent Television Authority, opened in October. A combined output of 10kW is obtained from two sets of 5kW transmitters operated in parallel from the control console in the foreground. The illustration on the LEFT shows part of the B.I.C.C. aerial mast for Mendlesham and the "Mesney" aerial system designed by E.M.I. Electronics, Ltd., to meet international planning requirements by providing an unsymmetrical radiation pattern.

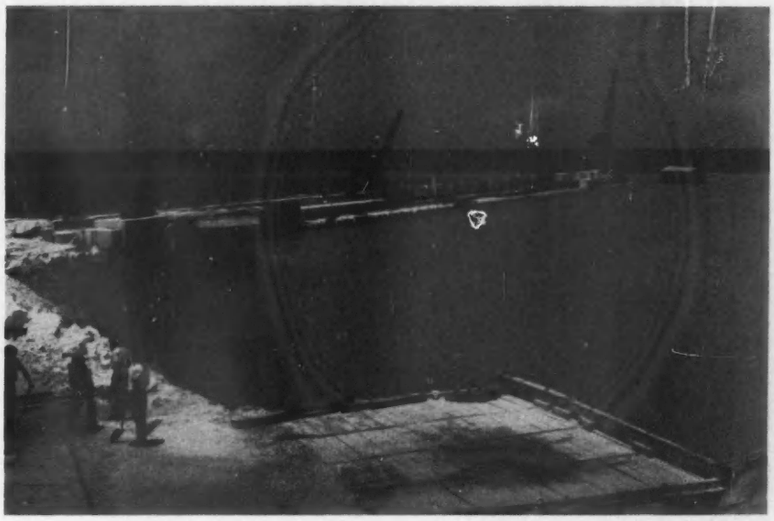
The contractor for the programme microwave link equipment for Mendlesham Station was Marconi's Wireless Telegraph Company, Ltd.; it consists of a duplicated unidirectional link from London with three repeater stations.



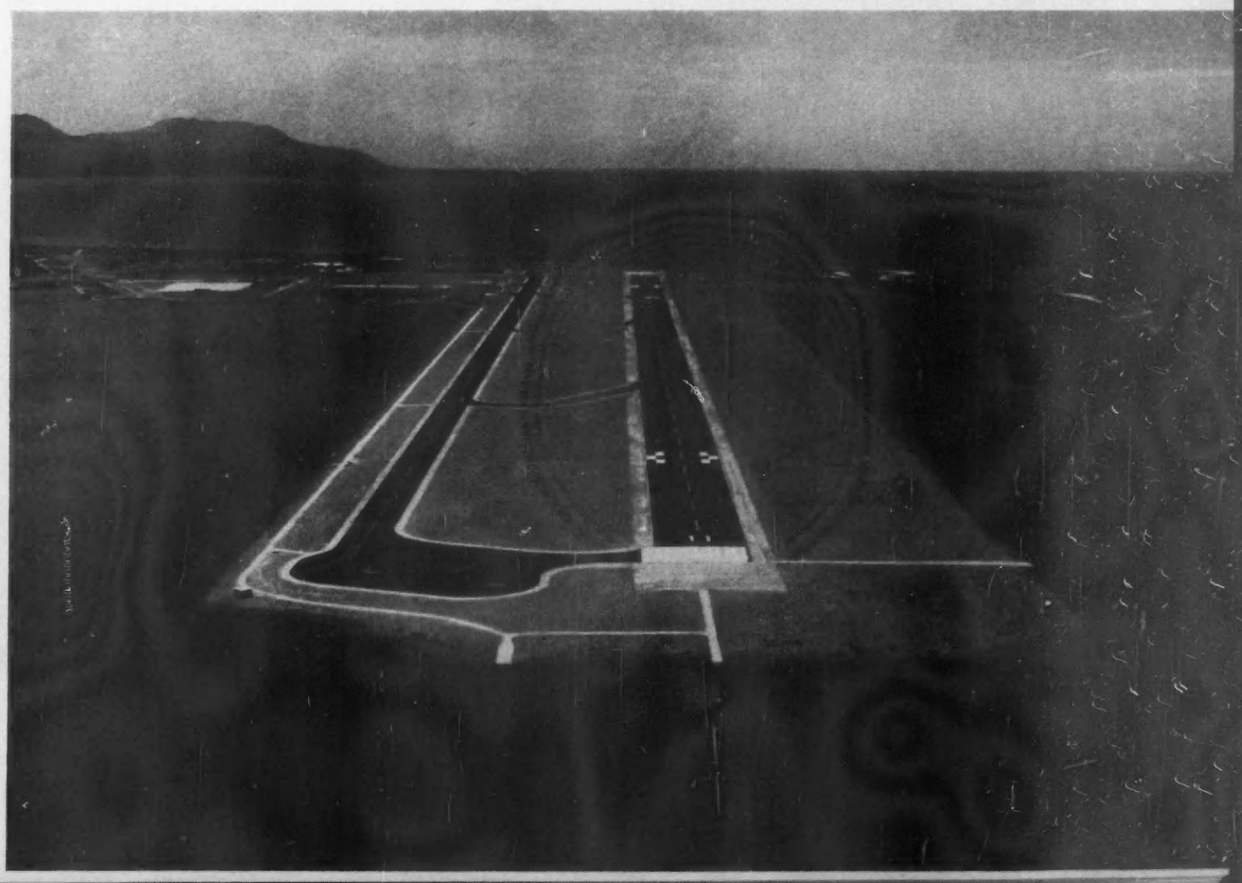
Construction Overseas

Nasiriyah road bridge (RIGHT), designed by Rendel, Palmer and Tritton for the Iraq Development Board, crosses the River Euphrates in three spans, one of 250ft and two anchor spans each of 170ft. It is mainly of high tensile steel with piers founded on caissons sunk well below scour level. There are pile-supported steel and concrete approach viaducts on each bank.

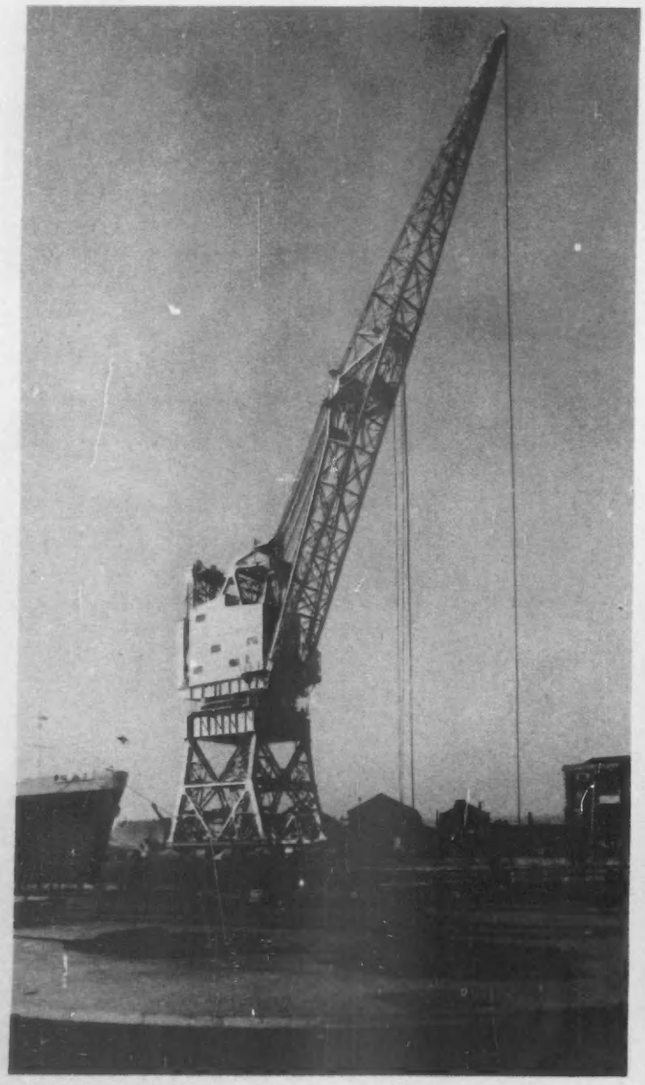
The deep water harbour at Bridgetown, Barbados (LEFT), costing £3,680,000, will be completed in 1961. (Consultants, Messrs. Coode and Partners ; contractor, R. Costain (West Indies), Ltd.) The breakwater will have inner and outer arms of 1006ft and 1712ft and is of solid concrete blocks of an average weight of 15 tons ; it is 37ft to 38ft wide, about 48ft 6in high, and rests on a 10ft rubble mound, 48ft wide, extending at least 5ft below the original sea bed. The sheltered area of water will be about 40 acres. The quay wall, also of concrete blocks set in sloping bond, is to be 1212ft long, with two transit sheds behind it. A further 500ft berth of cylinder construction with a r.c. deck slab will be constructed between the roots of the breakwater and quay wall. Spoil from dredging the harbour to 32ft below L.W.O.S.T. will be deposited behind the quay wall and the shore line to reclaim 87½ acres.



The new airport at Palisadoes, Jamaica (BELOW) formed by hydraulically placing gravel and sand, has one runway 7600ft long with 200ft stopways. The pavements are designed for use by "B-707" and "DC-8" aircraft. The majority of the pavement consists of dense, graded bituminous surfacing on a lean-dry rolled concrete base course. There is a sub-base of gravel stabilised by the addition of crushed limestone. The airfield lighting system covers the runway, traffic apron and the taxiways. Consultants, Sir Alexander Gibb and Partners ; contractor, J. Mowlem and Co., Ltd.

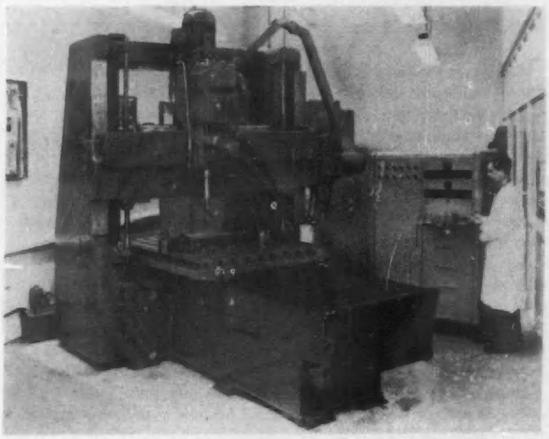


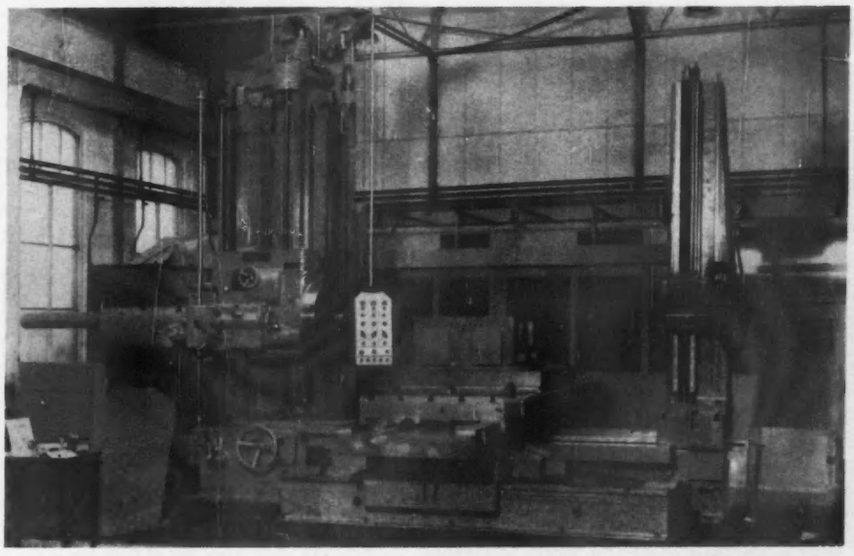
Cranes Amongst the cranes of particular interest we have described during the past year are the three illustrated on this page. The 400 tons capacity "Goliath" crane, RIGHT, was built by Babcock and Wilcox, Ltd., and placed in service for the construction of the Hinkley Point nuclear power station. It has an overall height of 240ft with a span of 250ft between the legs and travels 500 yards between the fabrication yards and the site of the station. Level luffing jib cranes are being used in increasing numbers in shipyards; that illustrated below (LEFT) was installed at the Queen Elizabeth Dock, Falmouth, by Stothert and Pitt, Ltd. It has a capacity of 48 tons at 105ft radius and 12 tons at 175ft radius. Provision is also made for the occasional lifting of loads of 61 tons on the main hook. The travelling monotower crane below (RIGHT) is one of four supplied by Butters Brothers and Co., Ltd., to the Greenock Dockyard Company, Ltd. It has a maximum lifting capacity of 25 tons at 90ft radius.



Automatically Controlled Precision Machine Tools

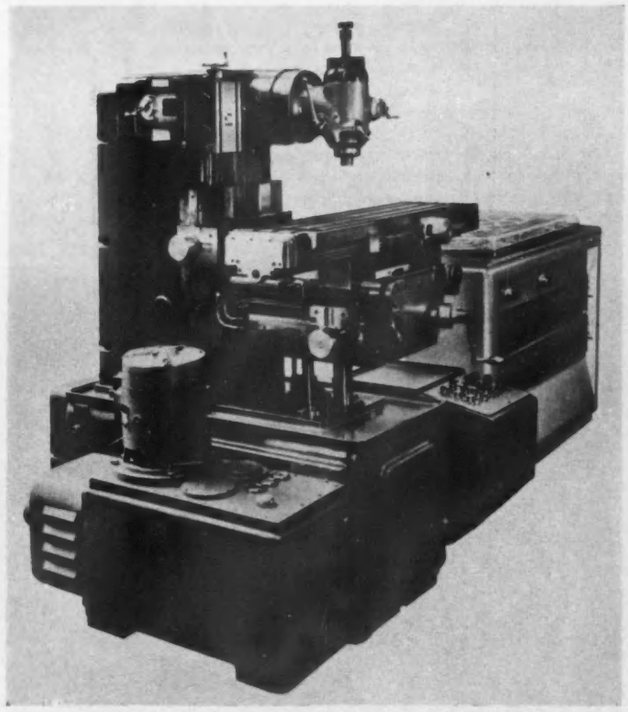
A considerable amount of development work has been carried out in this country in connection with equipments for the automatic co-ordinate setting and continuous control of precision machine tools, and a number of systems have been applied by British manufacturers. The drilling machine illustrated on the RIGHT, made by Wadkin, Ltd., has an electronic positional control developed by E.M.I. Electronics, Ltd. With automatic punched tape control, this machine drills holes up to 2in diameter within a stated accuracy of ±0·001in over its table area of 60in by 40in. An electronic automatic co-ordinate setting equipment of B.T.H. design is used on the No. 3 universal boring and milling machine of H. W. Kearns and Co., Ltd., shown BELOW. Through this setting equipment servo-mechanisms operate the vertical traverse of the spindle slide, and the transverse and longitudinal traverses of the compound table.

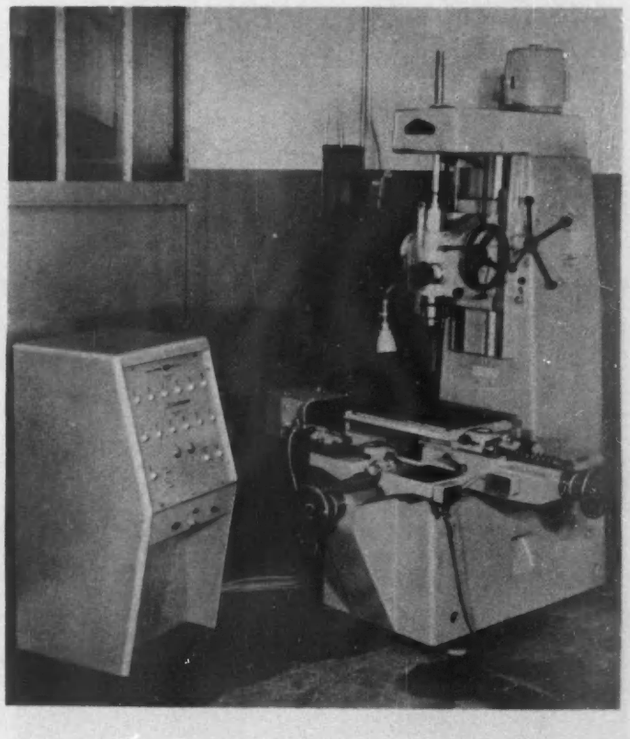




Below (LEFT) is illustrated a Hayes/Ferranti "Tapemaster" medium-sized vertical precision milling machine with three-dimensional control equipment. The Ferranti system provides continuous control, using magnetic tape, and operates from normal electricity mains supply. Hydraulic motors are controlled by electro-hydraulic valves and a simplified transistor circuitry for each function of the machine is contained in three replaceable trays in a control console.

The automatic positioning system fitted on the "Spacematic" jig borer of the Newall Engineering Company, Ltd., illustrated below (RIGHT) is designed to make possible greatly reduced production times when an overall working accuracy of 0·0005in is adequate. In the Airmec automatic measuring and control system used, no valves are employed, operation being effected by the employment of low-voltage d.c. switching circuits based upon G.P.O. relays. Ordinates are selected by dials or punched paper tape.

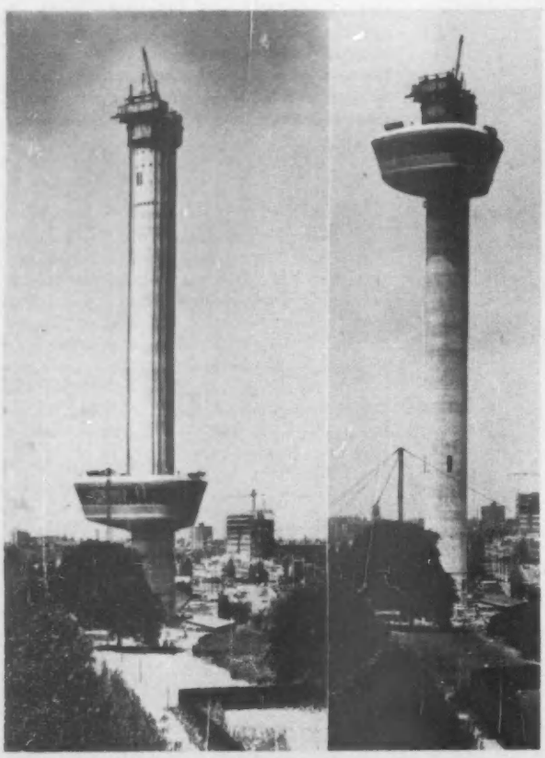


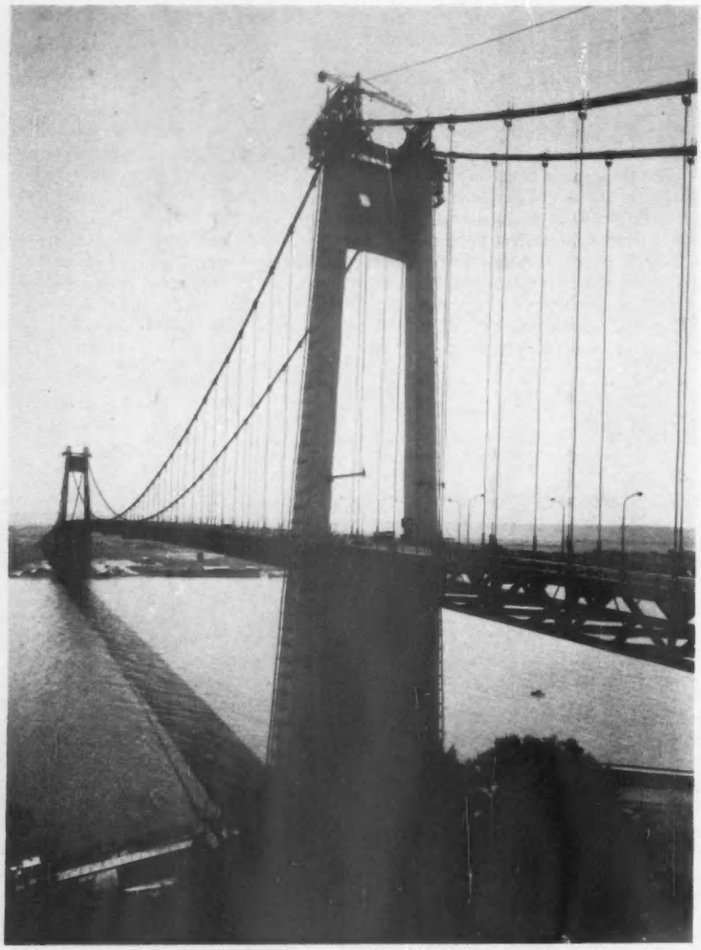


Continental Structures

On July 3, Tancarville Bridge (RIGHT) was handed over to traffic. The ninth longest suspension bridge in the world and the longest in Europe, it crosses the lower Seine with a main span of 608m and two side spans of 176m each. The towers, approximately 123m high, were constructed of concrete, the first time that has been done in a structure of this kind. Measures to increase wind stability included building the deck as a continuous, torsionally strong girder, and connecting the suspension cables to the deck at the centre of the main span. Also unusual is the large concrete abutment on the left bank which forms a counterweight hinged to the front caisson foundation by a Freyssinet hinge while the rear end, on which abuts the last span of the elevated concrete approach, rests on "Neoprene" bearings. The bridge was built by a group of firms including, among others, Baudin-Chateauneuf, Boussiron, and Campenon-Bernard; it is owned by the Chambre de Commerce du Havre and operated as a toll bridge.

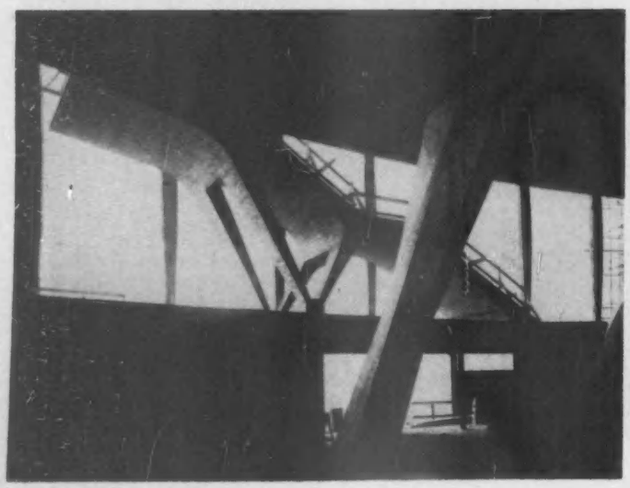
Like some other recent structures of its kind, the "Euromast" at Rotterdam (BELOW) serves a double purpose as a television transmitter and observation tower with restaurant. It comprises a tubular concrete tower of constant section which fact facilitated the use of sliding shuttering so that the whole height of 102m was built in twenty-three days. The steel structure for the restaurant was supplied and erected by N.V. Werkspoor, Amsterdam. It has a weight of 240 tonnes and is supported by twenty-four girders. Construction

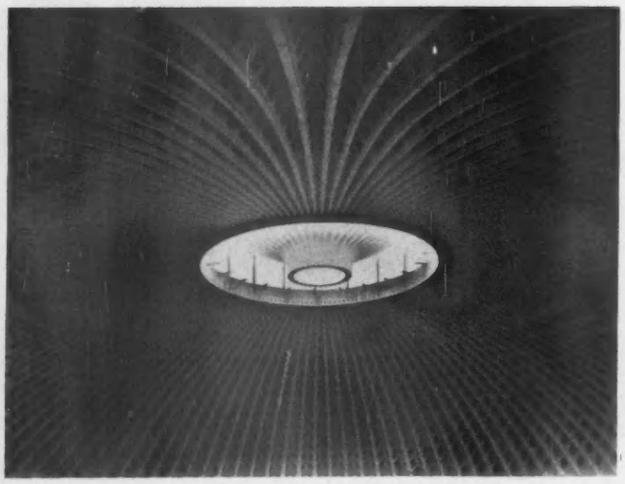




was made easier by building the "crow's nest" around the tower at ground level (LEFT) and then hoisting it into place (RIGHT) by means of hydraulic jacks installed on the top platform, using three strips of steel, a process which took five days to complete.

In preparation for this year's Olympic Games in Rome, a number of buildings have been completed which have a major structural as well as architectural interest. BELOW, LEFT, a detail in the Palazzo dello Sport, designed by P. L. Nervi and M. Piacentini, for 15,000 spectators The 280,000 cubic metre building is circular, of 122m outside diameter, with the main and secondary gallery surmounted by a dome measuring 100m across and having a radius of 82m. From the secondary gallery, decorative staircases lead to the higher levels. The supporting structures were cast *in situ*, against narrow-board formwork, giving a high quality of finish, while the cupola was constructed using a crane in the centre to place precast units on tubular scaffolding. Our last illustration shows the interior of the dome with its characteristic corrugations. Other Olympic buildings include the Palazetto dello Sport, for 4000 spectators, built by P. L. Nervi and A. Vitelozzi, as a cupola of 1620 elements of only nineteen different shapes, supported on "Y"-shaped inclined columns. The precast thickness of 2·5cm was increased to 5·5cm by *in situ* concrete.





The Iron and Steel Industry

FOR the British iron and steel industry, the past year has been, generally, a period of recovery from the recession which it experienced over the greater part of 1958. In 1958, it will be recalled, for the first time since the war, steel production declined by over 2,000,000 tons owing to lack of demand. That fall was associated, of course, with the general state of trade at home and abroad. At home, the effect was twofold ; the actual use of steel by industry declined and steel users and merchants ran down their stocks. The fall in steel output, however, was not evenly distributed. The continuous wide strip mills producing sheet and tinplate were able to work to capacity but plants producing sections of all kinds, particularly colliery arches, heavy sections and rails were hard hit. The result was that, when 1959 opened, the steel industry was operating at rather less than 75 per cent capacity. The most recent information is that that figure has now risen again to 95 per cent although there is still some variation in demand. Although steel producers' order books began to improve again quite early last year and deliveries of most descriptions of steel continued to show a "marked expansion" as the year went on, demands from the railways and shipbuilding and coal mining industries did not strengthen. In the third quarter, in fact, deliveries to those industries were lower than in the comparable period of 1958.

Another factor which has affected steel production over the last two years has been the variation in the volume of stocks held by consumers and merchants. The experience of the post-war years has shown that during a period of industrial boom and high steel demand, consumers add disproportionately to their stocks, whereas in a period of lower industrial activity and easy steel supplies stocks are reduced. The British Iron and Steel Federation has stated that, in the three years 1955 to 1957, consumers and merchants increased their stocks by the equivalent of 1,500,000 ingot tons, bringing their total stocks at the end of 1957 to over 6,000,000 ingot tons. There was a further increase of about 130,000 ingot tons in the first quarter of 1958, but after that the process was reversed. In the eighteen months from March, 1958, to September, 1959, consumers and merchants reduced their steel stocks by 1,600,000 ingot tons. Thus, stock increases which had inflated demand in the earlier period were followed by stock reductions at double that rate, which aggravated the falling off in steel demand in the latter period.

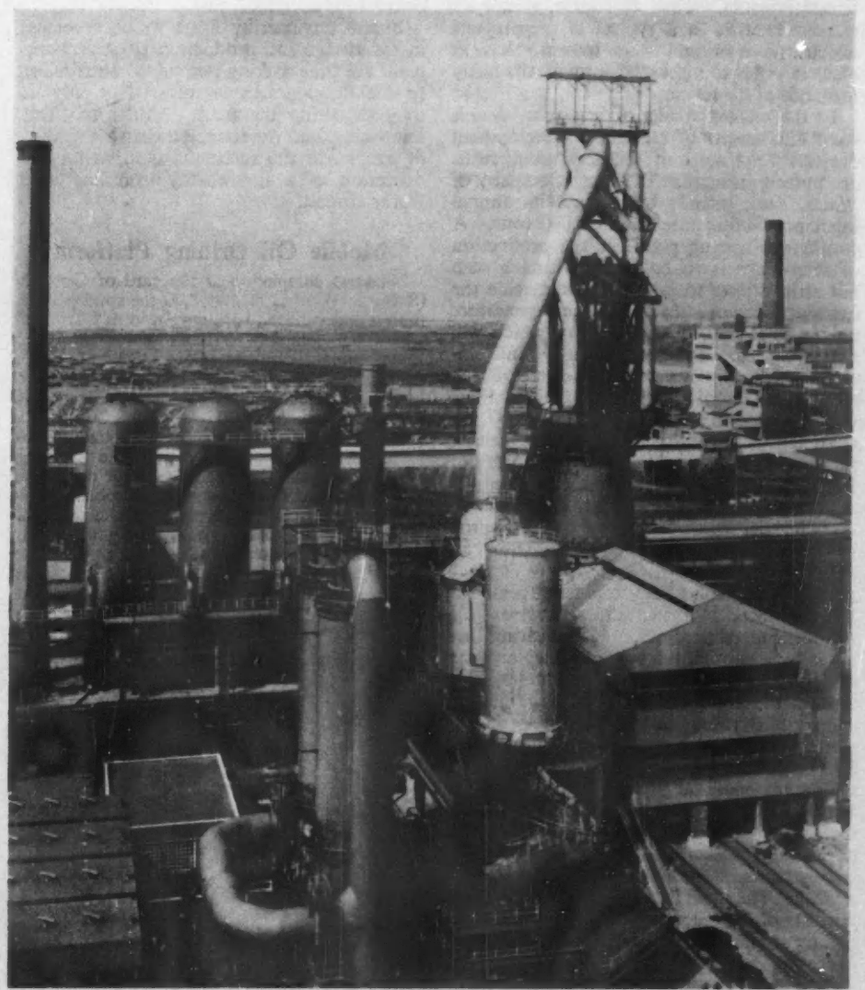
The final figure of last year's steel production has not been announced as we go to press, but there seems little doubt that it is about 20,000,000 tons. Taking the first eleven months, output was at an annual rate of 19,939,000 tons, but by the end of that period the annual rate was not far short of 24,000,000 tons. The progressive improvement in steel production has naturally led to greater activity at the blast furnaces. Towards the end of 1958, there were some blast furnaces temporarily idle but they have now resumed operations. The forecast made for 1959 was that there would be capacity for the production of 16,500,000 tons of pig iron. It is unlikely that that figure has been reached though it is significant that, in November, pig iron production was at an annual rate of 14,422,000 tons, compared with a rate of 12,155,000 tons a year earlier.

Modernisation and Expansion

In another article in this issue, reference is made to various developments in ferrous metallurgy during the past year. Then, in Plates 2 and 3, and herewith, there are illustrated a few examples of plant modernisation and extensions which were completed in 1959. Work on the schemes detailed in the iron and steel industry's third development plan (published in July, 1957) continued to make good progress throughout the year. There has been some re-phasing of certain portions of the programme but no major scheme has been held back on account of the recession through which the industry has passed.

Prior to the general election, there had been for more than a year a degree of uncertainty over the Labour Party's declaration about re-nationalising the steel industry. It caused some hesitancy in the investment of capital, but, nevertheless, the total amount spent on modernisation and expansion reached a record figure of £105 million in 1958 and it has been computed that in 1959 the industry's capital investment was maintained at the same high level. The industry's crude steel capacity was raised to about 23,500,000 tons in 1958 and to 24,500,000 tons in 1959, which means that, since 1946, there has been a net increase of 10,500,000 tons. In addition, an estimated 3,500,000 tons of existing crude steel capacity has been replaced by modern units during the post-war years.

The one product which continued to be in short supply during the recent recession was cold reduced steel sheet. Yet, since 1954, British steel producers have stepped up their deliveries of cold reduced sheet to home users by 57 per cent, that is from 960,000 tons in 1957 to over 1,500,000 tons in 1959. But even this increase in a relatively short period has not been quite sufficient owing mainly to the unprecedented increase in the output of motor-cars and domestic equipment. According to the British Iron and Steel Federation, the production of cold reduced sheet will continue to increase, during the next five years, by further expansions of the capacity of existing mills and by the construction of the two new wide strip mills at Ravenscraig, Scotland, and Newport, Monmouthshire. These two latter mills are not likely to begin production until the end of 1962. Nevertheless, it is stated that cold reduced sheet capacity this year should be about 2,190,000 tons, or 20 per cent higher than in 1959.



The No. 5 blast furnace at the Margam steel works of The Steel Company of Wales, Ltd., was blown in early in May. The furnace, which was built by Ashmore, Benson, Pease and Co., has a hearth diameter of 31ft, and is 250ft high

Substantial increases in output during the coming year will result from plant installed in 1959, notably at the strip mills of The Steel Company of Wales, Ltd., and John Summers and Sons, Ltd. Among other new plants which will shortly be started up are the South Durham Steel and Iron Company's extension which includes a blast furnace, steel melting shop, slabbing mill and four-high plate mill ; one new blast furnace each at Bairds and Scottish Steel, Ltd., and at John Lysaght's Scunthorpe Works, Ltd. ; a 75-ton electric arc furnace at the English Steel Corporation, Ltd. ; a four-high plate mill at Consett ; a two-high plate roughing mill at the Appleby-Frodingham works, Scunthorpe ; a three-stand billet mill at Colvilles, Ltd., Hallside ; a four-stand cold rolled medium-width strip mill at the Steel, Peech and Tozer branch of The United Steel Companies, Ltd., and an electric resistance weld tube plant at Stewarts and Lloyds, Ltd., Shotton works. This, of course, is not an exhaustive list ; it is typical of the projects which the iron and steel industry has in hand in order to meet efficiently all the likely demands of the future.

In the closing weeks of last year, details were announced of still more development projects which some of the steelmaking firms are putting in hand. The Steel Company of Wales, Ltd., intends to increase its annual ingot production rate to 3,650,000 tons. A continuous casting plant for the production of steel slabs is to be installed and a 48in hot strip mill is to be erected alongside the existing 80in hot strip mill. The expenditure envisaged is £30,000,000, part of which will be devoted to increasing the all-round efficiency of the Abbey works. The Steel, Peech and Tozer branch of The United Steel Companies, Ltd., is to spend £10,000,000 on replacing its twenty-one open hearth melting furnaces by six electric arc furnaces, each of 110 tons capacity. When this project is completed in five years' time, it is believed that it will constitute the largest electric steelmaking plant in the world with an annual capacity of 1,350,000 ingot tons of steel. A second development plan at Brymbo Steel Works, Ltd., involves the replacement of four old ingot reheating furnaces by a continuous bogie furnace and the installation of a new cogging mill. This follows the completion of the new melting shop at Brymbo in which three 45-ton electric arc furnaces are now operating. At Shepcote Lane Rolling Mills, Sheffield—which are operated jointly by Firth-Vickers Stainless Steels, Ltd., and Samuel Fox and Co., Ltd.—a £2,000,000 project has been approved for increasing the production of wide stainless steel coils from 450 to 800 tons a week. The main additions to the plant will consist of a second 42in Sendzimir cold rolling mill and a fourth softening and descaling line.

Durgapur

This review is, as usual, concerned mainly with the affairs of the British iron and steel industry. On this occasion, however, it is appropriate to include some reference to the progress at the Durgapur steel plant, in West Bengal, which is being built and equipped by a consortium of British firms operating under the title of Indian Steelworks Construction Company, Ltd. When the plant is completed, in April, 1961, there will be capacity for an annual production of 360,000 tons of pig iron and 1,000,000 ingot tons of steel. In addition, it is envisaged that a rolling mill and railway wheel and axle plant will have an annual production of about 790,000 tons.

The value of the complete contract, which was signed in October, 1956, is approximately £105 million. The first stage of the work is now finished. It includes the first coke oven battery, as illustrated on Plate 3, which was built by Simon-Carves, Ltd., and was started up in August, and a 27ft hearth diameter, blast furnace, built by Head Wrightson and Co., Ltd., and officially commissioned on Tuesday last, December 29. The first stage includes also a foundry and pattern shop and a central engineering maintenance shop. The second stage, which is nearing completion, consists of a second coke oven battery and blast furnace, a benzol rectification plant, the melting shop equipped with three open hearth furnaces, a 42in blooming mill, a continuous billet mill and a sleeper bar plant. The third and final stage involves the building of the third coke oven battery and blast furnace, the installation of another four open hearth furnaces, a 24in medium section mill and a continuous merchant mill.

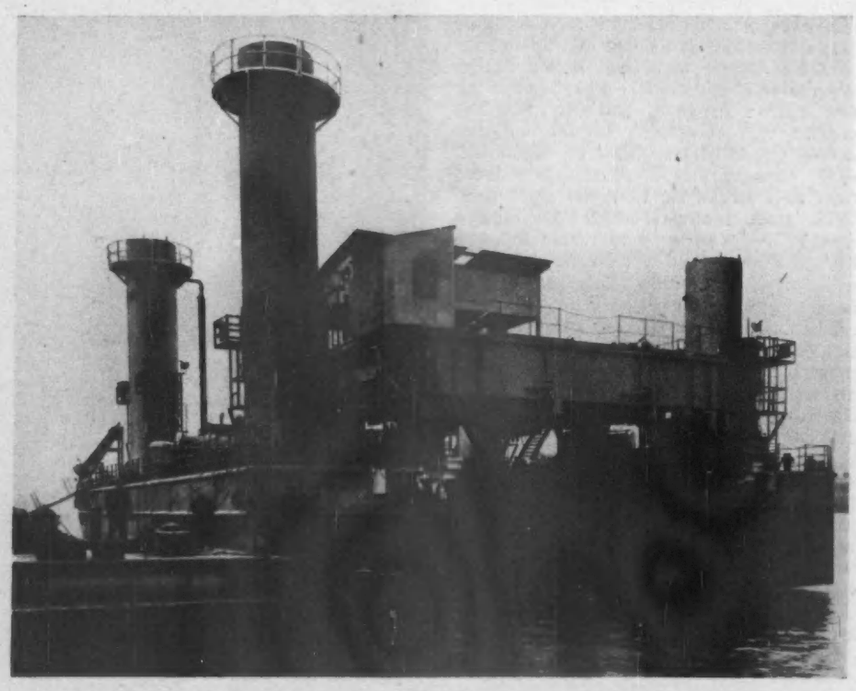
British engineering firms which specialise in the design and production of steel works plant are thus making a notable contribution to steel development overseas. Not only are they exporting the plant ; their technical knowledge and experience are also essential, of course, to the successful completion and operation of a noteworthy iron and steel works abroad.

Mobile Oil Drilling Platform

Nearing completion at the yard of Clelands (Successors), Ltd., Wallsend, is the spud pattern mobile underwater oil drilling platform " Triton," which the company is building for the Shell International Petroleum Company, Ltd. This drilling rig, shown legs spudded in and the hull raised nearly clear of the water in our illustration, was designed by the Shell Company's Dutch associates, Bataafse Internationale Petroleum Mij, in conjunction with the DeLong Corporation of America. The latter company, as the main contractor, has been responsible for the engineering and supervision of construction. About 1500 tons of steel have been worked into the platform, which has the following dimensions: length 115ft, breadth 80ft and depth 15ft; it has been built to operate in water up to 120ft deep. The " Triton " has been designed to withstand waves measuring 8ft from trough to crest and winds having a velocity of 75 m.p.h. under operating conditions. There are four retractable spud legs each 200ft long by 8ft diameter and having a wall thickness of about 1½in, and two heavy slotted jacking bars welded to them lengthwise and diametrically opposite each other. At present only an 80ft length of each leg has been mounted in order to ensure that the platform has adequate stability during the long tow to the operating site. The remaining lengths of leg, together with 16ft diameter footings, provided to limit soil penetration, will be stowed on deck when under tow.

Twin sets of hydraulic gear are fitted to each leg and have pins which lock into the jacking bars for raising and lowering operations. The jacking gear, which has been built by Woodfield Pickering, Ltd., to the designs of the DeLong Corporation, can raise the platform at a speed of 30ft per minute. For powering the hydraulic jacks there are eight pumps, arranged four to starboard and four to port in wing compartments within the hull, each driven by a 60 h.p. motor and rated at 3000 lb per square inch. Power for the pump motors is provided by four 136kW, 60 c/s Petbow alternators, each driven by a Rolls-Royce C.6. diesel engine and mounted in a centre compartment. Auxiliary machinery, which is located in a separate compartment, consists of a fuel oil pump driven by a 2 h.p. motor and rated at 770 gallons per minute at 25 lb per square inch, a 50 gallons per minute against a 60ft head fresh water pump powered by a 3 h.p. motor, and two bilge pumps rated to deliver 100 tons per hour against a 40/50ft head and driven by 10 h.p. motors, all supplied by Hamworthy Engineering, Ltd. The same company provided two compressors, one diesel driven and the other motor driven, each having a duty of 7·3 cubic feet per minute of free air at 350 lb per square inch.

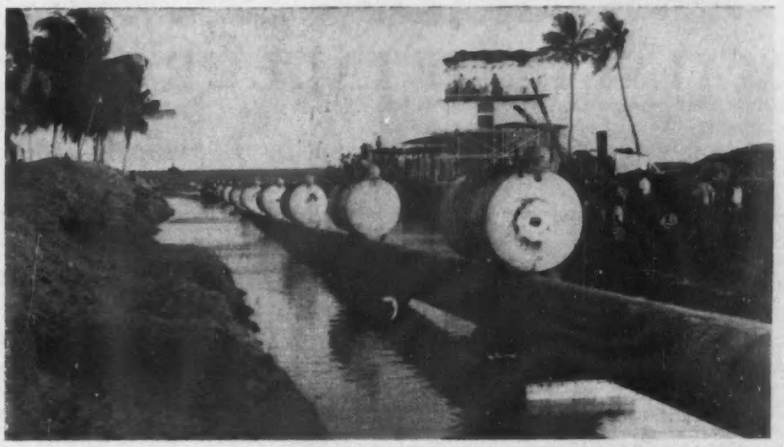
In a house on the main deck is a 45kW, 60 c/s alternator powered by a Meadows diesel engine for lighting purposes and a Hamworthy multi-stage centrifugal pump, driven by a Rolls-Royce C.6. diesel engine developing 100 h.p. at 1500 r.p.m., capable of delivering 500 gallons per minute against a 300ft head. For mooring and manœuvring, the platform is equipped with four electric deck winches built by Woodfield Pickering, Ltd. The engine house which is placed on a raised platform is designed to take Ideal draw-works and a drive group consisting of two Paxman " 12R.P.H." diesel engines. The drilling depth is 17,000ft.

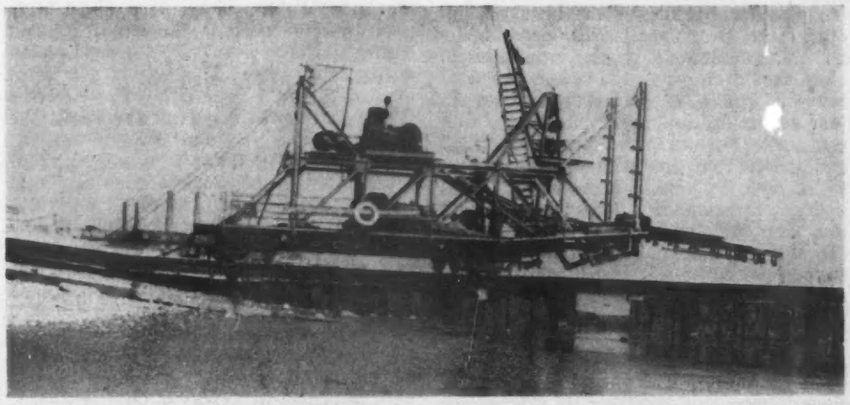


Drilling rig " Triton "; the platform is being raised

Sewage Outfalls

A sewer outfall from Tema, Ghana, 6000ft in length and of 27in internal diameter, RIGHT, was laid last October by Taylor Woodrow (Ghana), Ltd., and Collins Submarine Pipelines Overseas, Ltd. (consultants, D. Balfour and Sons). Short lengths of pipe were welded together, each length being coated successively with enamel, glass fibre and bitumen, and a 6in layer of reinforced concrete. The inside of the pipe was coated with a bitumen-sealed layer of cement mortar by a machine travelling inside it. Each weld was X-rayed. Each yard of completed pipeline weighed over 1 ton and measured 3ft 6in in diameter. The leading end of the pipe was encased in a 40-ton concrete sledge, which also helped to anchor the pipe at its final position on the sea bed in about 35ft depth of water. The pipe was pulled out to sea by a powerful winch stationed on a barge anchored outside the lagoon, pontoons giving buoyancy. These pontoons were later freed by a release mechanism operated by skin divers. Control was from a tower, communicating with the barge by radio-telephone.





An entirely different method of building a sewage outfall, extending 1650ft out to sea, was in use at Shoreham-by-Sea in Sussex. The rail-mounted carriage LEFT drives gantry piles from its cantilever frames and, inside them, further piles carrying the sewer. The sewer pipes are also laid by the machine, which was developed by J. T. Mackley and Co., Ltd. Full description, "The Engineer," August 28 last.

At the L.C.C.'s Northern Outfall, BELOW, a new diffused-air activated sludge plant of 60 m.g.d. nominal capacity was brought into use during 1959, and a large sludge digestion plant was largely completed, thus bringing to an end a programme of works costing about £9,000,000. This is the major example of sewage works construction of the past few years, and the works is probably unequalled in size in Europe. Full description, "The Engineer," October 30 last.

MAINLY METALLURGY

by T. Henry Turner, M.I.Mech.E., M.I.Loco.E., A.R.Ae.S., F.I.M.

Some Metallurgical Events of 1959

Professional Metallurgy

METALLURGISTS continued to increase in number during 1959 but the simultaneous increase in the number of advertisements for them clearly shows that they will be required in still greater numbers to meet the needs ; new industries, new colleges of technology, and expansion of all the university departments of metallurgy will call for ever more trained men. Some have been specialising in extraction metallurgy ; others in industrial metallurgy ; others in physical metallurgy or metallurgical physics.

Membership of the Iron and Steel Institute recently stood at 5209 and that of the Institute of Metals at 5019. This has been the first year in which it could be said that the active membership of both institutes exceeded 5000, but among these members are many who belong to both of these institutes. They are encouraged to do that because both of these bodies continue to co-operate together in many ways. For example, their joint library has become of national and, indeed, international importance and it is in process of expanding into extended premises at 4, Grosvenor Gardens, London, S.W.1. Similarly, both institutes have continued to help the Joint Group for Powder Metallurgy. This group has been so successful that it now has its papers printed in a separate publication, *Powder Metallurgy*, which is to appear half-yearly under the editorial and administrative guidance of the staff of the Institute of Metals. Set up in 1957, the Powder Metallurgy Joint Group published its proceedings for the third time and, as originally planned, held during 1959 two meetings at which many papers were presented and discussed.

Metallurgists had no professional organisation of their own, admitting only qualified metallurgists to membership, until, with the active help of both the Iron and Steel Institute and of the Institute of Metals, the Institution of Metallurgists was formed in 1945. Towards the end of 1959 membership of that Institution reached 4270, of which about 200 were Fellows, some 2200 were Associates and the remainder Licentiates with some 200 enrolled students. It should be noted that this increase in membership has been achieved despite the fact that there has been a stiffening in the already high standards of examination. The Institution of Metallurgists offices are now on the fourth floor of the same building which houses the Iron and Steel Institute and the Joint Library at 4, Grosvenor Gardens, London, S.W.1. The Education Committee of the Institution now numbers amongst its members representatives from the Iron and Steel Institute, the Institute of Metals, the Institution of Mining and Metallurgy, and the Institute of British Foundrymen. It is in touch with thirty-seven colleges in England and Wales, which have provided courses in metallurgical education approved for National Certificates in Metallurgy, and also with twenty-four colleges approved for the Higher National Certificates.

Thirteen universities in the United Kingdom now have metallurgical departments and courses leading to degrees in metallurgy. Note should also be made of the week-end refresher course, which is organised each year by the Institution of Metallurgists. In October, 1959, this took place in Scarborough and the four experts who were invited to speak on " Progress in Metallurgical Technology," entitled their lectures : (1) " Extraction and refining of ferrous metals " ; (2) " Extraction and refining of non-ferrous metals " ; (3) " Melting of ferrous and non-ferrous metals " ; (4) " Casting of ferrous and non-ferrous metals."

Three other bodies of especial interest to metallurgists and many engineers should also be mentioned. The Institute of British Foundrymen now publishes its proceedings monthly in quarto size, matching the journals of the other metallurgical institutes. The Corrosion Group of the Society of Chemical Industry has its papers printed on the same size of sheet in that Society's weekly publication, *Chemistry and Industry*. The transactions of the Institute of Metal Finishing now appear in similar quarto form as a dignified, glossy quarterly magazine. This standardisation of metallurgical and other allied journal sizes is welcome in many private and public libraries ; in each case the new journals are more easy to read.

Iron and Steel Metallurgy

When an engineer wishes to know what has been exercising the minds of those concerned with ferrous metallurgy he would be well advised to study the programme of the Iron and Steel Institute. In 1959 its traditional careful planning of its proceedings has been well maintained, its Joint Library extended, its journal enlarged, and the number of papers presented increased. The Institute arranged visits to works in the North East Coast and near Glasgow, and held two general meetings in London.

During the building operations at the rear of the main building of the Institute's headquarters, extending the basement and ground floors, the formerly very pleasant reading room had to be temporarily divided to house the over-congested library and crowded staff. This work should soon be finished to the benefit of the Joint Library and Information Department and of the members who use the reading room.

A somewhat unexpected new activity of the Institute was undertaken in 1959, when by arrangement with the Department of Scientific and Industrial Research it began the monthly publication of a complete English-language version of S.T.A.L. (Steel), a major Russian periodical in the sphere of iron and steel technology. This English version has the same sized type and paper as the Institute's own Journal, but so far carries no advertisements. English-speaking metallurgists and engineers in many countries may well find this new publication a welcome addition to the world's scientific literature.

The Institute's staff was preparing during the year for a symposium on wide strip, to be included in the annual general meeting which is to be held in London during May, 1960. This subject will be of interest to many engineers. For chemists and metallurgists the Institute started the organisation of a joint meeting on the Determination of Gases in Metals, in conjunction with the Society for Analytical Chemistry and the Institute of Metals.

Last May the papers at the 1959 annual general meeting of the Institute were presented in three simultaneous sessions. No less than eleven papers were presented in session A on " Recent applications of oxygen to steelmaking." Three papers were considered in session B on " The mechanism of bainite formation," and four papers were presented in session C on " Hydrogen in steel."

In December, 1959, at the Autumn general meeting, which took place rather later than usual, a further twenty-two papers were presented in six simultaneous sessions on respectively : " Forging," five papers ; " Extrusion," six papers ; " Fuming in steelmaking furnaces," six papers ; " Carbides and nitrides in steels," three papers ; " Controlled transformation," one paper ; and " Tempering of steels." These session headings neatly indicate the subjects which have exercised the minds of many ferrous metallurgists during the past year.

Plans for the coming year include in March a discussion, by the Engineers Group of the Iron and Steel Institute, of four papers on Heavy Plate Mills. The annual general meeting, early in May in London, is to be followed a month later by a Special Meeting in Italy ; the Autumn general meeting being planned for London at the end of November.

The Iron-Ore Situation in 1959

The world's iron-ore supplies have continued to meet the needs of the iron and steel industries, but the balance of location of supplies has greatly changed during the last twenty years. In the iron-ore business, in common with the steel business, there has recently been a trade recession which started in the U.S.A., where it was particularly severe, and later spread to most of Europe. It is now possible to survey the scene free from the abnormalities of war, but the effects of the abnormally long and still unsettled strike in the U.S.A. steel industry still cloud the picture.

The exploration and development of iron-ore fields in many parts of the world offer a feeling of security in the iron and steel

industries for many years to come. To the already well developed ore fields of Labrador, Venezuela, Liberia, and Peru, one may now add the discovery of further iron-ore deposits in Quebec, Labrador, Brazil, Mauretania, and French Equatorial Africa. These existing and potential sources of ore will entail the ore being seaborne.

In Europe the major source of iron-ore is Sweden where plans are now laid for substantial further development. How far the St. Lawrence River Development will affect the world picture as regards the shipment of iron-ore remains to be seen. The tendency at present is for the iron-ore business to have carriers designed especially to suit the job and concentrated attention has been devoted to the size and type of ship to be used solely for the carriage of ore. Bearing in mind the long experience with specially designed iron-ore ships on the Great Lakes, and the tendency in the oil industry to build ever larger tankers, one must expect iron-ore to be moved over oceans in very large carriers.

Unfortunately there are very few places where ore ships of about 50,000 tons may be loaded, as in Brazil and Mauretania, and their unloading is almost as difficult. So it seems that if it proves possible to load such large iron-ore carriers, a policy of transhipment, as at Rotterdam, will be adopted. The Steel Company of Wales and G.K.N. have a scheme at Milford Haven to handle really large ore carriers and tranship for delivery to the works further west.

The authoritative survey of the world's iron-ore supplies, which was produced by the British Iron and Steel Federation in 1951, was revised and re-issued in January, 1959, containing corrected figures for U.S.S.R. and additional figures for the recently discovered deposits in West Africa. A conservative estimate of 132,000 million tons of iron recoverable by present-day methods has been made. Beyond that, lower grade material, not now considered to be ore, could be utilised. Hence it would appear that there will not be a world shortage of iron-ore for a very long time to come.

Figures for iron-ore reserves in 1959 are given for each country separately. From these sixty-five countries (two in North America, eleven in South America, twenty-one in Europe, sixteen in Africa, fifteen in Asia and Australasia) four countries stand out as being far richer in iron-ore than all the others. The iron content of their ore reserves in millions of tons is: U.S.A., 20,086; Brazil, 20,925; U.S.S.R., 18,928; India, 37,940; and for comparison, one may add, United Kingdom, 1215.

Growth of Oxygen Steelmaking

Every steelmaking country evinced lively interest during 1959 in the methods of using oxygen in a variety of processes and types of furnaces. The last ten years have seen practical developments or planned use of the L.D. process in no less than seventeen countries. The Kal-Do process, now used in Sweden, should be operating in France also in 1960. The Rotor process, now used in Germany, is planned to be used in the United Kingdom and in South Africa. At the beginning of the year 1959 the annual ingot capacity of the L.D. process alone exceeded 10,200,000 tons and it is predicted that it will reach 14,000,000 tons by 1960. Many aspects of the use of oxygen in steelmaking were considered in an informative series of papers, which were written for the Iron and Steel Institute and discussed in May, 1959, at its annual general meeting in London. The use of supersonic speed oxygen gas is bringing about a revolution in steelmaking practice in many countries.

Growth of Electric Furnace Steelmaking

Electricity has long been used for making special alloy steels but until recently the very much greater tonnage of mild steel, and indeed of medium carbon, boiler and rail steels, came from acid or basic lined converters or from open-hearth furnaces which are fired by producer gas or oil.

But just before the end of the year the United Steel Companies, Ltd., announced that it would change over the Rotherham steel works of Steel, Peech and Tozer from open-hearth furnaces to electric arc furnaces. This is a bold move and when completed, in about five years time, it will create what may well be the largest fully electric steelmaking plant in the world, using some 750 million units of electricity a year. This will be six times as much as at present.

Six new electric furnaces are to replace the present twenty-one open-hearth furnaces. This will result in the removal of a well-known local landmark because it entails the demolition of the long line of fourteen 120ft high chimneys at the Templeborough works melting shop. The make of steel is expected to increase from the present 1,000,000 tons to 1,350,000 ingot tons a year. From the Clean Air Act point of view the Don Valley should benefit appreciably from this reduction in coal and oil burning at this famous steel works.

Continuous Casting of Steel

In June, 1959, it was announced that Barrow Steel Works were to install two continuous casting machines and a 20-ton electric arc furnace. These should produce 36,000 tons of steel billets a year, and make Barrow the first steel works to develop so as to depend on continuous casting for the bulk of its production. As indicated on Plate 2, this decision follows the successful completion of an experimental period. It is only during the post-war period that the steel industry has made useful strides in following the lead in continuous casting, which has been given by the non-ferrous industries.

The really notable feature at Barrow is that the speed of casting is two to three times faster than is known on any other installation. The twin-strand plant at Barrow casts small billets, mainly 2in squares, at 220in–360in a minute. In addition, large slabs up to 36in wide by 5½in thick, and blooms of 9in square, are being cast at Barrow by similar methods. The process offers a high yield of good quality, with relatively low capital outlay for the installation.

It has taken a very long time for the idea of continuous casting of steel to become a business. Sir Henry Bessemer tried to do it in 1856, but progress was negligible with steel, until success in the continuous casting of copper, brass, aluminium and other non-ferrous metals attracted attention, notably in Germany, and there was pilot plant activity in Russia for both iron and steel. This latter fact is underlined by the issue in July by the British Iron and Steel Federation of a pocket-sized concise English–Russian and Russian–English dictionary for continuous casting of steel.

After the war pilot plants appeared in Germany, France, Austria, the U.S.A., the U.S.S.R., and the U.K. The Low Moor Alloy Steel Works at Bradford installed a 2½-ton pilot plant in 1946, which has been operated on a production basis. The experiments in Barrow commenced in 1952 and in 1954 a 30 cwt pilot plant of a type developed by B.I.S.R.A. was installed in Sheffield. In a world survey of twenty-nine installations for continuous cast steel production it has been claimed that twelve of them are based in some measure on the Barrow plant. In January the United Steel Companies started pilot plant operation with a slab machine to cast 36in by 5½in slabs; the largest continuous cast section to be produced by a works sometimes in three-shift operation.

It is reasonable to think that eventually continuous casting will provide the bulk of slabs, blooms and billets for rolling. Many ingot casting pits will give place to continuous casting plants and arc furnaces are likely to be preferred as the steelmaking units. For the continuous casting of steel the road appears to stretch far ahead, full of promise, and for steelmakers it is attractive and exciting.

The Extrusion of Steel

To engineers and other users of steel, one of the most exciting fields of development during 1959 has been the hot extrusion of steel. A whole session was devoted to it at the autumn general meeting of the Iron and Steel Institute, and that may be regarded as a landmark. In recent years the process of the hot extrusion of steel has made great strides in the technique of working, and in the design of the presses and other essential equipment. At Chesterfield, where about 1930 stainless steels were first extruded into tubes, graphite lubrication was used. At Low Moor, glass lubrication is used, with a 1150-ton press, following the commercial development of that process by Ugine-Séjournet. Although the extrusion of solid sections and finned tubes is complex and the lubrication requirements critical, it is now clear that the process shows many advantages which should soon enable it to compete with jobbing mills.

It is not economical at present to use hot extrusion of steel for steel shapes which can be readily rolled, especially in mild steels or low alloy steels. On the other hand, non-standard shapes are often now more appropriate for extrusion and particularly so in relatively small orders because extrusion dies cost less than rolls. It is often possible to extrude sections which cannot be rolled, such as internally finned tubes. Moreover, sections may be extruded in highly alloyed materials which are difficult or impossible to roll, such as certain nickel-base alloys. Extrusion of stainless steels may now be economically justified, where quick delivery is essential, even at higher cost.

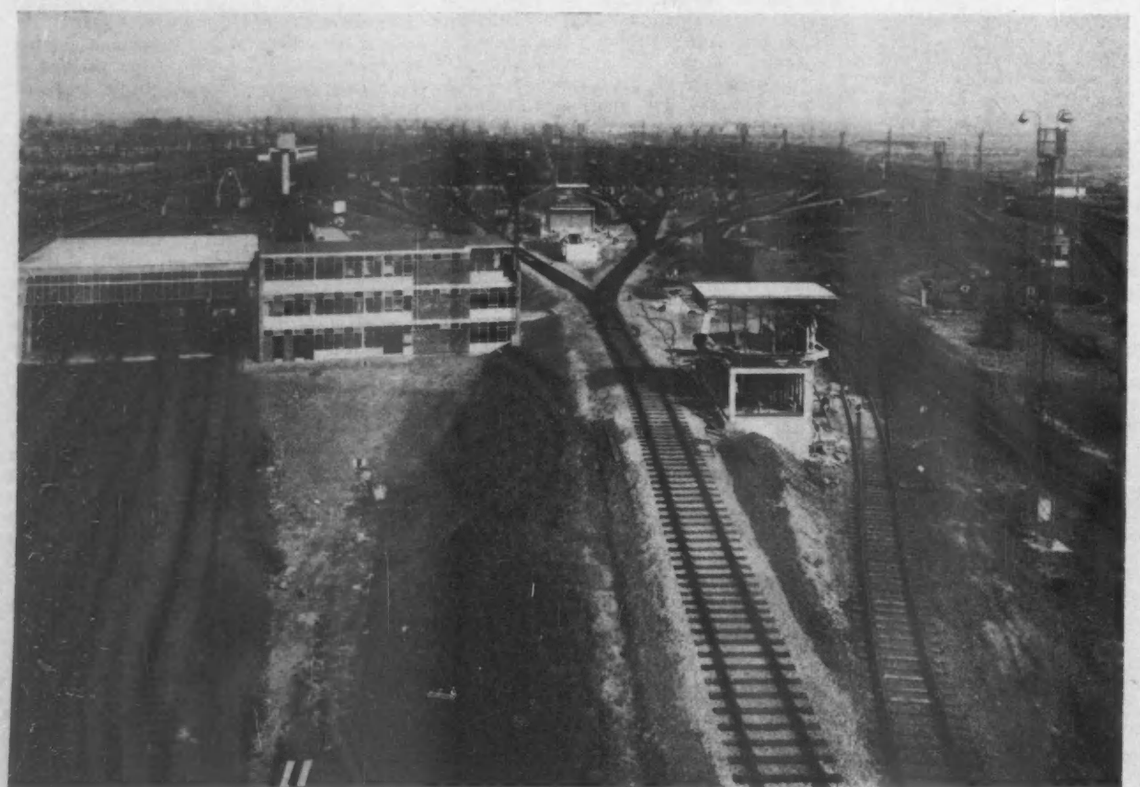
Extrusion of continuous cast steel billets has recently been the subject of pilot plant tests at Low Moor. Steel extrusion enthusiasts speak of extruding billets direct from large ingots. However that may turn out there can be no doubt that the glass lubrication technique has made steel extrusion another accepted means of fabricating steel on a commercial scale. Glass lubricated steel extrusion promises to be a great help with some of the high alloy steels, which are difficult to work by conventional methods. For example, architectural sections are easily possible in stainless steel but almost impossible by conventional rolling and machining.

Extrusion of steel may now play a part in many new engineering designs by making the use of previously unused shapes possible. But it will not compete with rolling for round or square sections in mild steel.

Railway Yards and Depots

A further scheme for concentrating wagon marshalling in East London was nearing completion at Ripple Lane, Barking, last year. The new yard (BELOW) will replace five existing yards, and trains approaching from both directions will be able to run direct into the reception sidings, thus simplifying the working of freight traffic in the area and doing away with inter-yard goods trains. During the current year Ripple Lane will come into operation as a mechanised hump yard, adding to the facilities already provided in East London during 1959 at Temple Mills, near Stratford. It is already in service as a flat yard. Consulting engineers for the scheme were Sir William Halcrow and Partners. Difficult ground conditions have made it necessary to pile all structures, involving a total of just over 1000 piles.

The new Upminster depot of the District Line, London Transport, was completed during the year. The viewpoint of our illustration (ABOVE), is one of the two Pirelli-General 150ft lighting towers in the depot yard, which carry respectively ten and twenty-one 1000W floodlights. The depot will accommodate thirty-four eight-car trains, and, with its 215ft lifting shop, provides full maintenance facilities at the eastern extremity of the District Line.



Shipbuilding and Marine Engineering in 1959

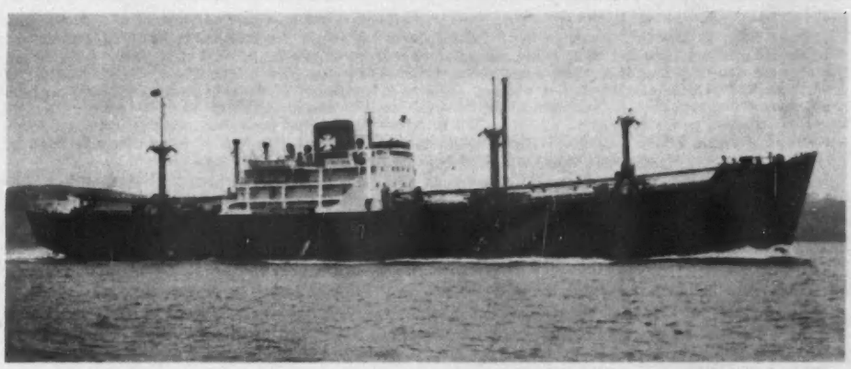
No. I

IT is to be regretted that all the factors which influenced the shipping position in 1958 continued to affect adversely the employment of ships in 1959. The level of the freight rate index remained, with slight variations, at about 70, which was depressingly low when it is considered that the basic figure of 100 is related to 1952. Since that year there has been a considerable rise in costs so that the figure quoted is rather better than that actually obtaining when current outgoings are taken into account. Under these conditions it is not surprising that the volume of unemployed tonnage continued to be round about the 1,000,000 tons mark. The continuance of these difficult trading conditions for a second year reduced the amount of new tonnage ordered to a mere trickle, the approximate total being 180 ships of 200,000 tons, against which had to be offset cancellations amounting to thirteen ships of 200,000 tons. Thus, considering tonnage only, the industry's order book was reduced, by the year's output from the yards, to about 4,000,000 tons, which represented a value of not much more than £600 million. This is, of course, a low figure compared with the quite unrealistic total attained in 1952, when orders were placed, for a variety of reasons, quite unrelated to productive capacity, steel supplies, &c., so that an enormous backlog of work resulted. Although the tonnage quoted above shows a steady reduction, some sense of proportion must be maintained and it must be remembered that the present total exceeds any of the totals recorded before the war. Of the ships on order, 57 per cent are oil tankers, 33 per cent are cargo ships and ore carriers, and 7 per cent represent passenger and passenger/cargo liners, while about 750,000 tons are for foreign account.

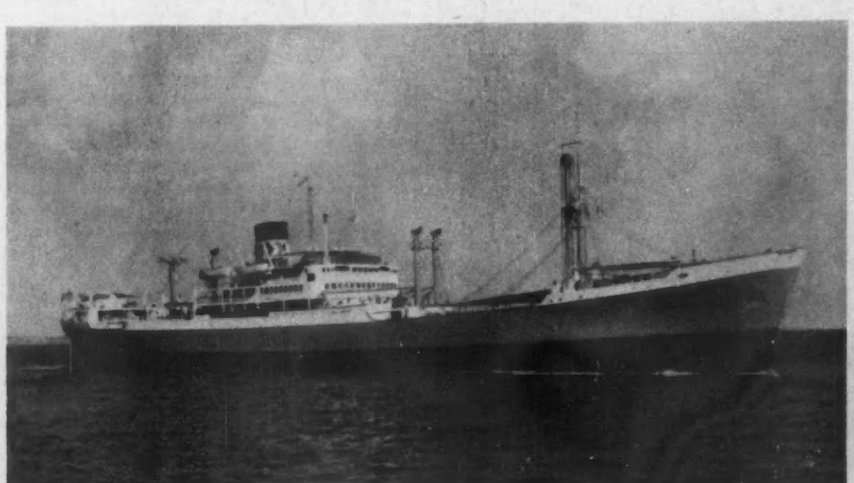
With reference to the placing of orders, comment has been made upon British owners ordering ships from foreign yards. Many factors affect this issue, which is not a simple matter of tonnage, for contracts sometimes have to be placed abroad for reasons of delivery related to the fact that berths of suitable size in the yards are already taken up. Of course, there is the all-important matter of cost for, as Sir William Currie has pointed out, it is only possible to order in Britain if the price of the ship permits the owners to compete in the market at world prices. Therefore, the cost of a ship must be in accord with the price at which the shipowner can sell his ships' services. To match quality with quality is not enough ; to-day, British prices must be equated with world prices.

With regard to the order book, it is felt that the market has been cleared of the speculative owner so that the prospective number of cancellations has diminished. Despite this, it is realised by the industry that although some owners will go forward with replacement programmes in order to have an efficient fleet, others wili delay completions because of lack of cargoes offering, while present indications of future shipping requirements may result in some ships not being built. Thus, the 4,000,000 tons order book may be optimistic of the true position. With this in mind, it is impossible to relate the tonnage on order to years of work, particularly since the non-tanker building yards find orders very hard to come by. This metamorphosis of the building scene, which has transpired in the last two years, reflects the continued recession in shipping, a recession which shows no sign of being dispersed, so that there would appear small hope of any significant revival in the placing of orders. Even should a demand for tonnage arise, there is a huge fleet of about 8,300,000 tons laid up in the world's ports, and of this total nearly 1,000,000 tons are British. Of course, it is realised that much of the idle tonnage will never sail again, since, of the total mentioned, approximately 6,400,000 tons were built before or during the war. What perhaps is more significant is that out of the 4,100,000 tons of dry cargo ships laid up, about 3,900,000 tons were constructed before or during the war. Scrap and build programmes have been advocated and British ships over twenty years old amount to about 14 per cent of the fleet, while the corresponding figure for the world is 18 per cent. However, to be in any way effective, it is essential that any such programme should be a matter of international agreement.

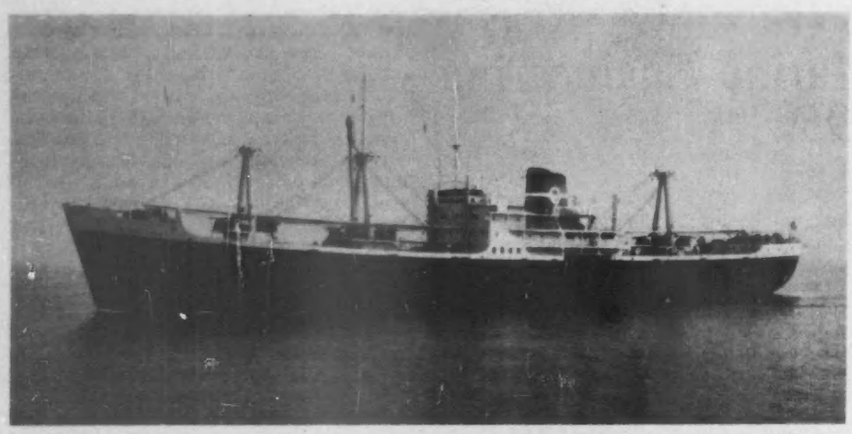
The greatest threat to shipbuilding in part comes from within the industry itself, since throughout the world there is an enormously increased building capacity. This is the result of many causes, such as national prestige, which supports the creation of an industry irrespective of actual needs or economics, and the expansion of capacity in shipbuilding countries through an over-optimistic assessment of future demands for tonnage, particularly with regard to oil cargoes. With a world fleet of approximately 120 million tons and a building capacity of about 10,000,000 tons, it is evident that, based on a ship having a working life of twenty years, a shipbuilding capacity of 6,000,000 tons is adequate to effect fleet replacement. Thus, competition for new orders is and will be of exceptional keenness, made all the sharper by reason of the subsidies paid in certain countries, or by the somewhat unreal credit terms offered as an inducement to build. With regard to the latter state of affairs, there is need for a



The Burntisland Shipbuilding Company, Ltd., completed the shelter deck cargo liner "Tewkesbury" for the South American trade of the Alexander Shipping Company, Ltd., and the ship has a length between perpendiculars of 430ft, a beam of 61ft 9in, and a depth to upper deck of 38ft 3in. The load draught is 28ft 10in, the deadweight is 11,900 tons and the cargo is carried in five holds, three forward of and two aft of the machinery space, served by one 50-ton, six 12½-ton and eight 5-ton derricks. Propulsion is by a Hawthorn-Doxford two-cycle oil engine, burning heavy oil and rated at 5500 b.h.p. at 115 r.p.m., while three 200kW diesel-driven generators provide electrical power



The Strick cargo liner "Baharistan" was built by The Caledon Shipbuilding and Engineering Company, Ltd., and the ship carries 10,950 tons deadweight on 27ft 5½in draught and the following dimensions ; length overall 511ft, breadth 63ft 3in, and depth to upper deck 33ft 9in. There are five holds, one 65-ton, one 15-ton, four 10-ton, four 7-ton and six 5-ton derricks, and steam deck machinery. Three 100kW steam-driven generators provide electric power and a sea speed of 15 knots is maintained by six-cylinder Hawthorn-Doxford oil engines developing 6500 b.h.p. at 115 r.p.m.



The Palm Line, Ltd., took delivery of the "Ibadan Palm" from the Neptune works of Swan, Hunter and Wigham Richardson, Ltd., and on trial the ship attained a speed of 15¾ knots. Of open shelter deck design, the ship has five holds and three bipod masts and a complement of one 50-ton, four 15-ton, two 10-ton and ten 5-ton derricks served by sixteen electric winches. The main particulars of the ship are: length between perpendiculars 430ft, breadth 62ft 6in, depth to shelter deck 36ft 11in and a deadweight of 8950 tons on 25ft 1½in draught. Electric power is supplied by three 250kW Allen diesel-driven generators and the main machinery consists of a Swan, Hunter-Doxford diaphragm oil engine having four cylinders of 670mm bore by 2320mm combined stroke and rated to deliver 4500 b.h.p. at 118 r.p.m.

Government assessment of the situation and for improved bank support. The position now reached means that under any rational form of building programme, all the shipbuilding berths cannot be occupied, unless aided by political manœuvre, while every shipyard built abroad reduces the potential of our orders for export.

The shipbuilding firms have always been aware of the eventual strength of the competition to be faced from foreign yards once reconstruction had been completed. To meet this, the yards, while continuing to maintain production, have steadily gone forward with extensive modernisation and re-equipment schemes designed to improve efficiency so that quicker deliveries may be effected and building costs reduced. The work has proceeded, not without difficulties, since most British yards are restricted in area and so have little room for expansion. However, over £100 million has been spent by the various shipbuilding firms to provide new slips and cranage, prefabrication shops and fitting-out jetties, &c., to improve the competitive strength of the yards by giving the workers the best equipment. Of course, to achieve the purpose of this capital investment it is essential that the best use is made of the new tools. No doubt some time will elapse before the effect of modernisation and reorganisation will be fully reflected in production figures. Nevertheless, some benefit has already been apparent in a number of yards, such as Austin and Pickersgill, Ltd., and Bartram and Sons, Ltd., while the newly-modernised yard of Charles Connell and Co., Ltd., has recently completed a 9550-ton deadweight ore carrier in thirty working weeks, a production rate which the company hopes will enable it to face successfully present intensive competition. Although the new equipment will enable the yards to construct more efficiently and rapidly, it must not be overlooked that any resultant reduction in costs only applies to about 40 per cent of the price of a ship, since shipbuilders, apart from building the hull, are assemblers to produce a final product. Thus, the major part of the cost of a ship is dependent upon the manufacturers of auxiliary fittings and equipment and it is hoped that they also will put their houses in order and support the efforts of the shipbuilders to achieve fixed prices and firm delivery dates.

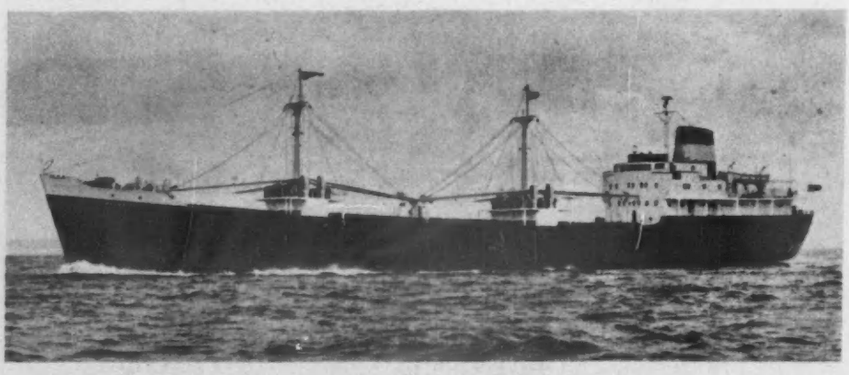
Capital expenditure and planned production based upon new techniques and modern tools will achieve nothing without the full co-operation of labour, for it is only by the united efforts of all that the continued existence of the industry will be ensured. Much rests upon the shoulders of management in avoiding anomalous situations and keeping employees informed regarding developments. Trade unions, on the other hand, must collaborate in the introduction of new methods, remove restrictions upon output, agree to the rational manning of machines, and ensure discipline among their members. No doubt, endeavours have been and are being made in this direction, as instanced by the support promised by the unions to Bartram and Sons, Ltd., to enable the firm to obtain a contract upon terms of fixed price and guaranteed delivery. This state of affairs was not general and during the year there were several unofficial strikes and deplorable demarcation disputes, the toll of which was clearly set forth in the report issued by Alexander Stephen and Sons, Ltd. This high-lighted the reduction in the numbers employed, the loss in wages, the loss of business sustained by sub-contractors, the reduction in the amount of steel worked and, not least, the overall reduction in the firm's earnings. The report emphasised that the dispute resulted in everyone concerned suffering losses, while the firm has suffered a major setback, such that retrenchments had to be made in expenditure upon plant improvements, and the company had been unable to tender seriously for orders offering. With a shrinking order book, a decreasing demand for tonnage coupled with increasing competition such that price is a major factor in obtaining orders, the recent claim made by the unions for wage increases and shorter hours can hardly be called helpful and certainly indicates little understanding of the difficulties presently facing the industry. Only increased productivity, involving the co-operation of the unions, can offer any

TABLE I—*Ships Under Construction*
Tonnage Given in Thousands of Tons Gross.

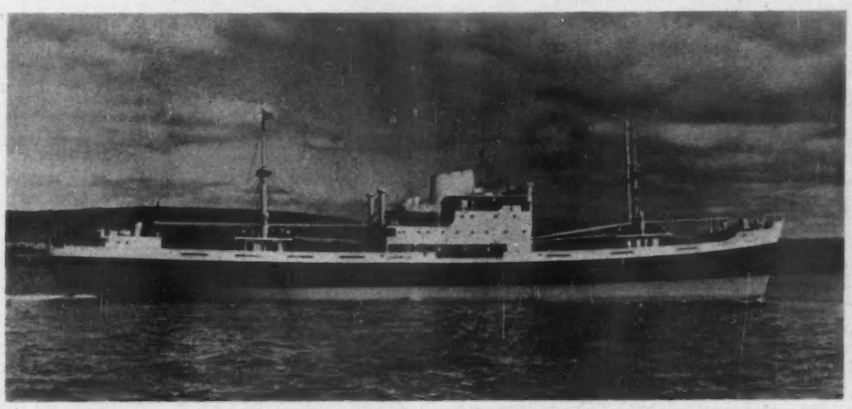
Year ended September 30	World, tons gross	Great Britain		Japan		Germany	
		Tons gross	Percentage of world	Tons gross	Percentage of world	Tons gross	Percentage of world
1956	7,449	2,078	27·9	1,193	16·0	823	11·1
1957	9,351	2,241	24·0	1,480	15·8	827	8·9
1958	10,206	2,299	22·7	1,170	11·4	1,103	10·8
1959	9,814	2,098	21·4	1,207	12·3	968	9·9

TABLE II—*Tonnage Commenced, Launched and Completed in Great Britain and Other Countries*
Tonnage Given in Thousands of Tons Gross.

Year ended September 30	Great Britain			Other countries		
	Tonnage commenced	Tonnage launched	Tonnage completed	Tonnage commenced	Tonnage launched	Tonnage completed
1956	1,321	1,350	1,417	5,618	4,796	4,446
1957	1,592	1,445	1,457	7,680	6,634	6,227
1958	1,386	1,457	1,364	8,047	7,806	7,394
1959	1,184	1,313	1,421	6,929	7,557	7,238
Change	−202	−144	+57	−1,118	−249	−156



The bulk sugar or ore carrier "Holmside" was built for The Burnett Steamship Company, Ltd., by Hall, Russell and Co., Ltd., and equipped for navigating the St. Lawrence Seaway. A six-cylinder, single-acting, two-stroke, Clark-Sulzer oil engine, developing 3000 b.h.p. at 150 r.p.m. and placed aft, propels the ship and three 125kW diesel-driven generators supply electrical power requirements. Eight 5-ton derricks serve the four holds which are fitted with single pull hatch covers. The ship measures 370ft length between perpendiculars, by 53ft beam by 28ft deep and has a deadweight of 6500 tons on 22ft 3in draught



Harland and Wolff, Ltd., completed the "Somers Isle" at Belfast for the Pacific Steam Navigation Company, and the principal dimensions are: length between perpendiculars 370ft, breadth 54ft, depth to upper deck 33ft 6in and gross tonnage 5700. The cargo is carried in four holds and handled by one 25-ton, four 10-ton and eight 5-ton derricks powered by electric winches. Propulsion is by a Harland and Wolff, single-acting, two-stroke, opposed piston diesel engine having four cylinders of 620mm bore and a combined stroke of 1870mm and being fitted with two turbo blowers. To meet electrical demands there are three 175kW diesel-driven generators. A ship of similar dimensions, the "Eleuthera" was completed for the same owners by Hall Russell and Co., Ltd.

possibility of reduction in working hours without a cost penalty. Indeed, it is questionable if the present forty-four-hour week is being worked when all the various stoppages, late starting and early stopping, extended mid-day breaks and other practices are taken into consideration. Labour intransigence is no help in assisting the industrial clock to be fully wound up, and perhaps the conditions in Sweden may be a pointer to sensible labour relations. In that country there is, for all practical purposes, only one union for negotiating purposes, demarcation problems are practically non-existent, "wild-cat" strikes are illegal and there is a wide degree of consultation between management and labour.

In Table I is recorded the tonnage of ships under construction in this country and our closest rivals, as published by Lloyd's Register of Shipping, and it shows that the world tonnage dropped, as did the totals for Great Britain and Germany, while Japan made a slight recovery from the large fall recorded in 1958. It is a serious thought that our share of the world total dropped to a new low of 21·4 per cent. Japan easily maintained second place with Germany continuing to occupy third place and Sweden taking over fourth position from Italy. From consideration of the grand total, let us look at the returns of tonnage commenced, launched and completed as set out in Table II. In this country the tonnage commenced continued to drop sharply by an amount similar to last year and the cumulative effect was reflected in a considerable reduction in the tonnage launched. That part of the table dealing with other countries shows that, in distinct contrast with last year and the preceding years, there was a reduction in all three categories, that in tonnage commenced being of considerable magnitude.

In Table III all three categories of tonnage are listed quarter by quarter for the twelve months ended September 30, 1959, and then the average quarterly value is added to the returns for the first nine months of the year to provide a rough estimate of the possible totals for the whole year.

TABLE III—*Tonnage Commenced, Launched and Completed in Great Britain, Japan and Germany*

Tonnage Given in Thousands of Tons Gross.

Period in quarters	Great Britain			Japan			Germany		
	Tonnage commenced	Tonnage launched	Tonnage completed	Tonnage commenced	Tonnage launched	Tonnage completed	Tonnage commenced	Tonnage launched	Tonnage completed
December, 1958	362	390	441	307	414	479	379	424	383
March, 1959	319	270	312	569	473	390	308	308	332
June, 1959	189	363	417	423	347	438	214	294	300
September, 1959	313	289	251	369	472	336	261	277	266
Total for twelve months	1,183	1,312	1,421	1,668	1,706	1,643	1,162	1,303	1,281
Average per quarter	296	328	355	417	426	411	290	326	320
Total to September, 1959	821	922	980	1,361	1,292	1,164	783	879	898
Estimated for 1959	1,117	1,250	1,335	1,778	1,718	1,575	1,073	1,205	1,318
Returns for 1958	1,312	1,395	1,464	1,647	2,056	2,235	1,458	1,459	1,355
Differences	−195	−145	−129	+131	−338	−660	−385	−254	−37

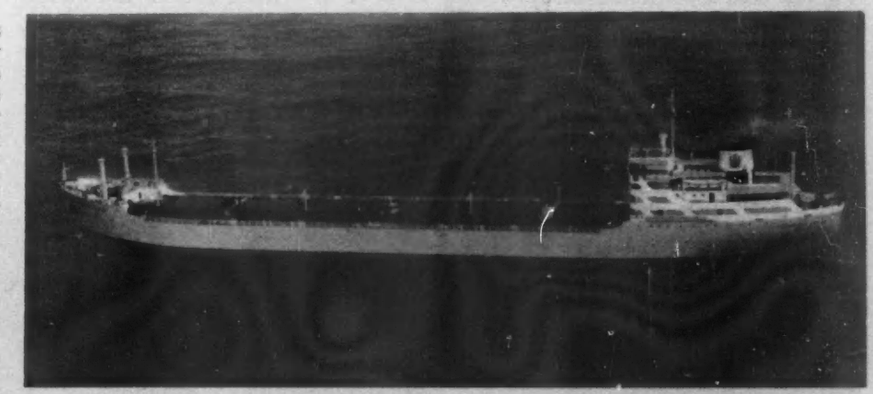
In Great Britain the drop in the tonnage commenced in the second quarter and the lower return for the tonnage launched in the first and third quarters, together with the fall in tonnage completed in the third quarter, must adversely affect the year's totals, unless there was a considerable recovery in the last quarter of the year. Similar trends apply to Germany and also to Japan, where the tonnage launched and completed shows large reductions. Nevertheless, despite the general recession in all three countries, Germany maintained parity with Great Britain, while Japan continued to have a substantial margin in her favour and to occupy the position of the world's leading shipbuilding country. Although Britain may lead in the matter of tonnage under construction, the earnings and therefore the prosperity of the industry largely depend upon the tonnage completed. In this, Japan clearly built at a higher rate, although it must not be forgotten that the tonnage built in the United Kingdom covers a wide variety of ships, including liners and special purpose ships, in which a smaller tonnage is of much greater value.

TABLE IV—*Tonnage Under Construction for Export*

Country	Percentage of own tonnage	Percentage of world tonnage
Great Britain	11·0	6·2
Japan	63·4	20·6
Germany	75·0	19·6
Sweden	63·5	14·5
Italy	36·3	7·7
Netherlands	37·0	7·6

The figures given in Table IV represent the position at the end of the third quarter of the year when, throughout the world, 3,711,632 tons were under construction for export. The second column indicates the share taken up by the six leading countries while the first column sets out the comparative dependence of each country upon orders for export. The figures broadly indicate both the strength and weakness of the industry in these countries, several of which are obviously capable of winning orders and at the same time are dependent upon contracts from abroad.

As in previous years, the building of oil tankers was the mainstay of the industry in most countries, as the following figures indicate: in Great Britain tanker tonnage represented 48·9 per cent of the tonnage under construction, the corresponding percentages for Japan, Germany, Sweden, Italy and The Netherlands being 61·2, 40·0, 69·6, 63·1 and 57·4. Related to world construction, the percentage was 53·2. In this country the remainder of the tonnage under construction on September 30 included passenger and passenger/cargo liners, 13·5



The ore carrier "Bamburgh Castle" was constructed at the Neptune works of Swan, Hunter and Wigham Richardson, Ltd., to the order of The Bamburgh Shipping Company, Ltd., and carries a deadweight of 16,750 tons on 29ft 6in mean draught. A speed of 14 knots was attained on trial and the propelling machinery, placed aft, consists of a four-cylinder Swan, Hunter-Doxford oil engine, designed for 4200 b.h.p. in service at 110 r.p.m., and fitted for burning boiler fuel. There are three 200kW diesel-driven generators and the ship's dimensions are: length between perpendiculars 485ft, breadth 70ft, and depth 40ft 9in. Each of the two ore holds is served by three hatches fitted with MacGregor steel covers

per cent; cargo liners, 17·5 per cent; cargo tramps, 10·5 per cent.

Mention has been made already of the unprofitable level of the freight rate index at which the shipowners have had to seek cargoes to keep tramp shipping sailing and themselves in business. However, the greater danger to existence continued to be the severe handicap occasioned by the overall effect of flags of convenience, flag discrimination, and state subsidies. When it is considered that about half the cost of a new American ship is provided by the Government of the U.S.A. and that the other half can be paid through the medium of cheap mortgage rates and that, furthermore, the American owner may receive an operating subsidy, then the handicap to the unsubsidised British owner is clearly apparent. To this burden is added that of the bilateral or unilateral action of governments to reserve cargoes for a particular flag. Since about two-thirds of foreign countries practise some form of flag discrimination, then it is inevitable that the invisible exports earned by British shipping are adversely affected. This is confirmed by the report of the inquiry, made by the Chamber of Shipping of the United Kingdom, into the contribution made by the industry to the balance of payments. The figure returned for 1958 was £135 million, which can be compared with £221 million for 1952. With a very substantial part of the world fleet sailing under flags of convenience and thus operating tax free, the menace is such that it must undermine the strength of our position and increase the proportion of our imports and exports carried by foreign shipping.

Interference by governments inevitably results in dislocation of any effective shipping system so that goods can no longer be transported economically. British shipping cannot combat arbitrary decisions of foreign governments by business acumen, so there is need to reconcile conflicting shipping policies by international co-operation if the free flow of trade, upon which British shipping depends, is to be restored. If the present situation cannot be resolved, then one shipowner has suggested that it will be necessary to adopt a policy designed to safeguard our interests and to accord to shipowners similar forms of protection so that they can operate on terms of economic parity. This densely populated country, depending for its existence on industry and foreign trade, can only live by owning an adequate merchant fleet which, in turn, must be backed by up-to-date shipbuilding and ship repairing industries. These are hard facts which deserve a position of high priority with the Government.

(To be continued)

Glasgow Railway Electrification

SECTIONS of the Glasgow suburban railway system on both banks of the Clyde, totalling 71 route-miles, are in course of electrification, and public services with electric trains on the north side lines are due to begin this year. Work on the section north of the Clyde—Helensburgh to Airdrie via Glasgow, Queen Street (Low Level), and branches—is well advanced. South of the river the section being electrified extends from Glasgow Central round the Cathcart Circle line, and over the connecting lines to Neilston High and Kirkhill. All the electrification is on the single-phase, 50 c/s system. The voltage in the central Glasgow area is 6·25kV because of clearance difficulties at tunnels and bridges. In the outer area the voltage will be 25kV. This is the first railway electrification on any system in Scotland (excepting the Glasgow subway), and we have received the following account of the present state of the work from the Scottish Region of British Railways.

In the Glasgow city area there was a particularly large number of tunnels and overbridges where the clearance was less than that required for the overhead equipment. Some idea of the density of this work will be gathered from the fact that the track is being lowered under thirty-eight bridges, and through ½ mile of tunnel; thirty-two bridges are being raised, and ninety-five entirely reconstructed, including thirty-four footbridges. Where road bridges are being reconstructed, prestressed concrete is being used for the superstructure and a uniform design in steelwork has been evolved for the new footbridges. A temporary Bailey bridge carrying road traffic before erection of the prestressed concrete superstructure is illustrated.

Queen Street Low Level Station in the centre of Glasgow is in process of being remodelled and two spacious platforms are replacing the four platforms which existed previously. At other stations, platforms have had to be raised or reconstructed for clearance purposes, and, where required, lengthening is in progress to accommodate six-car electric trains.

The realignment of the permanent way north of the Clyde is almost complete and work is proceeding on the south side also. An increased depth of ballast is being provided under the sleepers. Where necessary, track is being blanketed and additional drainage provided. Junctions are being remodelled to ease speed restrictions and the layout at terminal stations has been, or will be, altered to suit electric train working.

Three new power signalboxes and five smaller ones have been constructed, together with relay rooms at new and remaining boxes. Feeder stations and track-sectioning cabins have been provided as required throughout the routes, a rolling stock maintenance shed has been constructed at Hyndland, and an electrical control centre is nearing completion at Cathcart.

Electrical Engineering

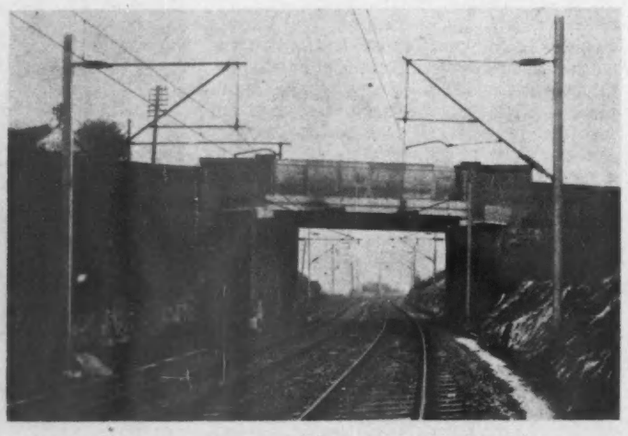
Good progress has continued on all aspects of the work during 1959 in preparation for the opening of the north side lines to public service some time during 1960. Construction work on the overhead line contact system is well advanced. To date over 3000 foundations and approximately 2500 masts have been installed and over 60 miles of overhead wiring have been run out. Two forms of cantilever mast for open line and at overbridges are seen in one of the illustrations. Surveys for the overhead system were carried out by British Insulated Callender's Cables, Ltd., and the contractor for the installation is Pirelli-General Cable Works, Ltd.

The first power supply point for the electrification, at Parkhead feeder station, was commissioned on May 4, 1959. The sub-feeder stations at Finnieston and Westerton, together with the 25kV cable feeding them from Parkhead, were energised on May 6, 1959. This cable, which is of concentric design and filled with nitrogen gas at an approximate pressure of 200 lb per square inch, is the first of its kind to be used by British Railways.

After a series of precommissioning tests, trial running with electrical multiple-unit sets began between Westerton and Milngavie for test purposes and the training of staff on July 12, 1959. This section of line will form part of the Central Glasgow area of the electrification, where the voltage of the overhead contact wire system is 6·25kV because of clearance difficulties with tunnels and bridges. In the outer area, however, the voltage will be 25kV and trial running at this voltage on a section of line between Westerton and Singer Workers Platforms began on September 7, 1959. The change in voltage takes place at a neutral section ¼ mile west of Milngavie Junction. This was the first operational use in Great Britain of a neutral section of this kind for voltage changeover.

Construction of the new electric control station at Cathcart, which will control power supplies throughout the electrified area, is well advanced, as is the new rolling stock maintenance depot at Hyndland. Installation work in the feeder stations, sub-feeder stations and track sectioning cabins is proceeding in accordance with programme.

Temporary Bailey bridge on the Balloch branch. The original arch was demolished by explosives without damage to the temporary span



Bridge near Drumchapell after being raised to provide electrical clearance. Note special cantilevers for suspending catenaries under the bridge

SHORTER REPORTS

Zenith Research Reactor at Winfrith

THE " Zenith " reactor at the United Kingdom Atomic Energy Establishment, Winfrith, Dorset, began operation for the first time at 5.30 a.m., on December 19. The final stages of commissioning the installation will be carried out during the next few months. " Zenith," which is the first reactor to be built at the Winfrith establishment of the United Kingdom Atomic Energy Authority, will be used initially by the international staff of the O.E.E.C. High Temperature Reactor Project to establish design characteristics for a 20MW high-temperature gas-cooled reactor experiment called " Dragon " which is to be built at Winfrith.

The " Dragon " project is a joint undertaking by the United Kingdom, Austria, Denmark, Norway, Sweden, Switzerland and the European Atomic Energy Community, Euratom (Belgium, France, Italy, Luxembourg, The Netherlands and West Germany), over a five-year period from April 1, 1959, to design, construct and operate a high-temperature gas-cooled reactor experiment : the project has its headquarters in the United Kingdom at the Atomic Energy Establishment, Winfrith, Dorset. An Authority team was responsible for the basic conception of " Zenith," for the approval of contractors' designs and for the inspection and commissioning of the plant. The fuel elements and nucleonic instrumentation were designed and produced by the Authority.

The main contractor for the reactor was the Atomic Energy Division of The General Electric Company, Ltd., Erith, Kent. The total cost of the reactor was about £400,000. Eighty-five firms were subcontractors for the reactor installation.

" Zenith " has been built to operate under temperature conditions similar to those expected in a high-temperature gas-cooled power reactor. The reactor core consists of a nearly cylindrical assembly of 235 fuel elements, 8ft high and 4ft in diameter, in the form of graphite cylinders, containing pellets of fissile uranium oxide, fertile thorium oxide and graphite, arranged in regular patterns. The ends of the fuel elements are made of solid graphite, which, with a 3ft thick graphite annulus surrounding the fuel, form a reflector to return some of the neutrons escaping from the fuel into the core, so reducing the quantity of fuel used. The reactor core is enclosed in a pressure vessel through which the nitrogen gas is pumped in a continuous closed circuit. A 200kW heater heats the nitrogen as it enters at the bottom of the core : the hot gas raises the core mean temperature to 800 deg. Cent. At the top of the core the hot nitrogen is mixed with cooler gas before passing through the reflector : thus the reflector is kept at a mean temperature of 400 deg. Cent. To maintain the purity of the nitrogen at the operating temperature a purification system is used to remove traces of carbon monoxide and carbon dioxide. The reactor pressure vessel and associated plant is enclosed in an airtight containing building. The reactor itself will be operated at a peak neutron flux of 10^8 neutrons per square centimetre per second at a maximum nuclear power of 100W : the nuclear heat produced is thus negligible in comparison with the energy used to heat the core.

" Zenith " is controlled by neutron absorbing rods in the graphite reflector. There are thirty control rod holes disposed in a ring round the core : twenty of these holes are occupied by motorised control rods and fixed absorbers may be loaded into the other ten holes. The twenty motorised rods include safety rods, shut-off rods, temperature rods and a coarse and a fine control rod. Six flux measuring chambers are positioned in other holes at the inner edge of the reflector. There are four pulse-counting fission chambers, two for use at high power and two at low power, and also two current fission chambers feeding shut-down amplifiers. Activity in the fuel elements will be at a low level because the reactor power will not exceed 100W ; this permits easy rearrangement of the core. For the first two years after commissioning " Zenith " will be used to check reactor physics design calculations for the " Dragon " high-temperature gas-cooled reactor experiment.

Henley's

TO-DAY, exactly 123 years after William Thomas Henley started his first workshop in Hayden Street, The Minories, London, the firm that he founded becomes part of Associated Electrical Industries, Ltd. With the current reorientation of cable making in the A.E.I. organisation, one link with the pioneer days of the industry will disappear, for cable production is now being gradually run down at North Woolwich, on the site where Henley established a factory a hundred years ago. However, another link with the past will be preserved, since the A.E.I. production of paper insulated cables is being concentrated at Gravesend, where, in 1906 W. T. Henley's Telegraph Works Company, Ltd., built a new factory for the manufacture of impregnated paper insulated cables. Several extensions have been made to the works and to the research laboratories built in 1922. Another Henley factory was opened at Birtley in 1950 and the A.E.I. cable division will continue to use it for the production of rubber and thermoplastic insulated cables.

A short history of Henley's was given in a booklet by Mr. Ernest Slater, published in 1937, when the company celebrated its centenary. Bearing in mind that more than two decades of development have been recorded since this centenary booklet was written, it is perhaps worth while to recall some of the landmarks. During the early years of the company, which included the lifetime of its founder (W. T. Henley died in 1882), most of its business was concerned with the manufacture of submarine telegraph cables, as the firm's name indicates. Henley made the 1615-mile-long Persian Gulf cable which was laid in 1863 and has been claimed as the first major length of submarine cable that was a complete and lasting success. After having been consulted in the investigations into the failure of the 1858 Atlantic telegraph cable, Henley was responsible for making the heavily armoured shore ends of the successful Atlantic telegraph cables of 1865 and 1866.

With the passing of the Electric Lighting Act of 1881, there began a rapid growth in demand for cables for lighting and power and there was a corresponding diversification in the company's products. Impregnated paper insulated cables were introduced in 1890 and soon became widely used for mains and distribution systems. Early in the present century, 11kV was the highest voltage used for public electricity supply. Seven years after the opening of the Gravesend works, the company was making 22kV and 25kV cables, including substantial lengths of three-core cable for railway electrification in South America, and some of these installations are believed to be still in service. By the early 1920s the firm was making 33kV cables. Difficulties with ionisation in the cable dielectric were met and overcome. Progress had to be rapid to match the demand for higher voltages and 132kV cables were being made by the 1930s.

During the 1939–45 war, Henley's and Siemens were associated with the development and manufacture of the submarine fuel pipeline " Pluto." In 1954 Henley's made, for the Electricity Department of Belfast, the first 110kV three-core oil-filled cable to be installed in the British Isles. Two years later, at Agecroft power station, Manchester, the company made and laid the first 132kV three-core oil-filled cable in the United Kingdom.

National Boat Show

IN London, on Wednesday, December 30, the sixth annual National Boat Show, an event organised by the Ship and Boat Builders' National Federation and sponsored by the *Daily Express*, was opened at Earls Court by Mr. Heathcoat Amory, the Chancellor of the Exchequer. The Show, which will remain open until Saturday, January 9, has doubled in size in the space of five years and has benefited by the additional floor space made available by the move from Olympia to Earls Court. Here full use has been made of the pool to form a harbour in which demonstrations of life rafts and underwater swimming are being given. Again, a large number of craft, over 350, are displayed by an equally large number of exhibitors. The craft on view include the 50ft ketch, Melora III ; a 52ft Monaco twin-screw cruiser ; a glass-fibre lifeboat for the Orient liner " Oriana " ; an example of a " Gannet " class motor tug ; the recently introduced Dowty jet turbo craft ; together with a variety of dinghies and other small craft. Various makes of diesel and petrol engines having a range of power suitable for the craft on view are displayed, together with a comprehensive selection of auxiliary equipment. A number of small craft, none of which cost over £150, demonstrate boating-on-a-budget, while the build-it-yourself boatyard demonstrates small boat construction.

High-Power Broadcast Station for Ghana

THE Government of Ghana is to establish at Tema, near Accra, a high-power, short-wave broadcast station capable of giving effective coverage on the h.f. band of the whole African continent, and of achieving world-wide coverage when required. Marconi's Wireless Telegraph Company, Ltd., Chelmsford, Essex, which has been awarded a contract for building and equipping the station, states that four 100kW h.f. transmitters will be installed, of a design (BD253) which operates in the range 5·9 to 26·1 Mc/s. Tuning controllers, electrically-operated from the front panel, will enable any one of six pre-set crystal frequencies to be set up by a single attendant in three minutes. Tuning procedure will be simplified by a mimic diagram containing anode and grid meters for all stages.

For each transmitter the English Electric Valve Company, Ltd., Chelmsford, is supplying two BR155 and four BR189 forced-air-cooled triodes. The BR155 valves will be used in the cathode-driven penultimate r.f. stage for applying cathode drive to a pair of BR189 final r.f. amplifiers. The second pair of BR189 valves, operating under class B conditions, will be used in the modulator stage. A cathode follower drive enabling up to 26 dB of negative feedback to be applied will operate the modulator, and the a.f. filters normally associated with modulation transformers have been eliminated. The BR189 valves for these transmitters have thoriated tungsten filaments running at 9V, 240A, and may be operated with a maximum of 15,000V on the anodes. Each valve is mounted on runners so that it can be withdrawn from the transmitter for transfer to a valve trolley. The relatively small size of the valves (547mm overall length and 346mm maximum overall diameter) enables them to be handled without lifting tackle.

The aerials to be used are h.f. dipole curtain arrays suspended between lattice steel masts fed by four-wire open feeder lines. In all, six 325ft masts, three 235ft masts and four 90ft masts will support twenty-two aerials. A completely automatic remotely-controlled aerial switching unit is to be installed in the transmitter building, and will comprise about ninety-two aerial switches, designed to switch any of the four transmitters to any of the twenty-two aerials.

SHORTER REPORTS *(Continued)*

The general layout of the buildings comprising the Tema transmitting station will be a hollow square. On the south side of the enclosed courtyard will be a two-storey building, the ground floor of which will house the four 100kW transmitters (with space for a fifth should occasion arise) and the cooling and smoothing enclosures. The second storey will contain the aerial switching equipment. In front of this main building, a single-storey structure will contain over a dozen rooms, the central (and largest) being the transmitter control room. Two covered ways will connect this area to a single-storey administration block on the opposite side of the courtyard. The station has been specially designed to take into account the possibility of earthquake shocks and the effect of solar heat and salt-laden air on the buildings. Consulting architects for the building to Marconi's Wireless Telegraph Company, Ltd., are Messrs. Kenneth Scott Associates, London and Accra. The quantity surveyors are Messrs. Widnell and Trollope.

Transistorised Temperature Controller

WE illustrate an assembly of three temperature controllers which are among the first products of a three-year development programme on transistorised industrial instruments undertaken by the Bangor research laboratories of Fielden Electronics, Ltd., Paston Road, Wythenshawe, Manchester, 22. A platinum resistance element is used at the temperature measuring point and may be connected to the controller by up to 300ft of ordinary cable. The controller circuit consists of an amplifier and a bridge circuit energised from the amplifier output and connected to feed the out-of-balance voltage back into the input. When the bridge passes through balance its output changes in phase by 180 deg. and this effect can be made to cause the complete circuit to oscillate. When the circuit is oscillating an additional winding on the coupling transformer provides an a.c. voltage which is rectified and used to operate a relay, giving an on/off control action which may be either electrical or pneumatic. The controller requires a 12V d.c. supply, for which mains units are available.

Three temperature controllers incorporating bridge sensing and transistor amplifier circuits in meter pattern cases

The instrument, known as the "Bikini" precision temperature controller, is housed in a small meter pattern case and occupies a panel space 4½in in diameter. The scale, which is 9in long, is calibrated directly in deg. Cent. or deg. Fah, and the pointer is set to the required control temperature by a small knob in the centre of the instrument. A red lamp visible from the sides as well as from the front indicates the control action. Control can be at any temperature between −200 deg. and +500 deg. Cent., with a minimum temperature range span of 50 deg. Cent., and there are twelve standard calibrations in Centigrade and Fahrenheit degrees.

[Reply Card No. E281]

Rust Proofing

WE are informed by the Walterisation Company, Ltd., Purley Way, Croydon, Surrey, that it has developed a new processing technique involving a combined degreasing and phosphating solution. At the moment, this technique is applicable to the firm's "Fasbond" highly accelerated zinc phosphating solutions, and in it a new solution called "Waltersolv" is added to the phosphating baths which are made up in the normal manner. "Waltersolv" consists of degreasing and emulsifying agents in solution in a high boiling point fraction derived from petroleum. As it has a flash point of 120 deg. Cent. and a boiling point of 260–290 deg. Cent., there is some fire hazard, particularly if spillage occurs on to an open flame. It is not, therefore, recommended that the process should be used in tanks heated by an open flame; steam or electricity are the preferred methods.

The "Waltersolv" is added direct to the phosphating bath to approximately 10 per cent of the bath capacity. Whilst a proportion of the "Waltersolv" is taken up by the phosphating chemical to form an emulsion, the bulk of it floats on the surface, to provide a blanket on the surface, preventing the loss of heat and steam from the processing solution. Preliminary results are stated to indicate that a saving of up to 75 per cent of heating costs can be made and, due to its high boiling point, very little of the "Waltersolv" is lost by evaporation. Although degreasing and phosphating can be carried out in the one solution, the grease which is removed from the surfaces is absorbed into the processing solution and a build-up of emulsified grease and soil occurs. Periodical skimming or syphoning off the top solvent layer and replacing with new "Waltersolv" will reduce the frequency with which it will be necessary to discard the whole solution.

[Reply Card No. E282]

Direct Reading for Data Processing

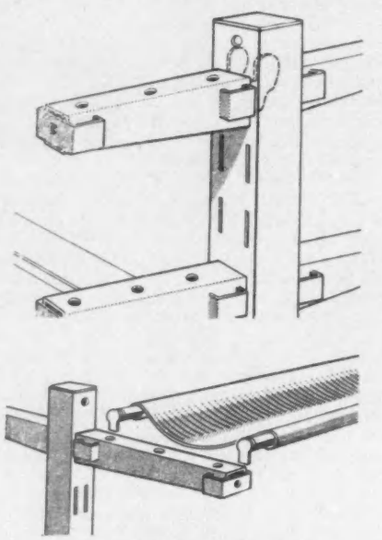
DETAILS of a new method for the recognition of printed figures have been announced by De La Rue Bull Machines, Ltd., 114–118, Southampton Row, London, W.C.1. With this system there is no need for transcription of data from a document into perforations on a card and then a repetition of this operation for checking purposes. Figures are produced in a magnetic ink which can be printed by any of the accepted printing processes, and appear in a form which is instantly readable by the human eye. Each figure is printed in the form of a series of vertical lines spaced either 0·2mm or 0·4mm apart. The basis of the reading system is that the magnetic ink appearing in the vertical lines is simply an alerting signal to the interpreting equipment and the actual interpretation of the printed figures depends on the relative dispositions of the wide (0·4mm) and the narrow (0·2mm) spaces.

The normal numerical code is obtained by using seven vertical lines, giving six spaces, of which two are wide and four are narrow. The spaces between different figures are sufficiently great for the reading apparatus to turn itself off and a quick-acting delay mechanism allows six spaces to have been read before the interpreted figure code is transmitted for subsequent data processing or for direct recording. It is stated that the same principle can be applied to the reading of alphabetical information. Characters encoded in vertical lines can be read and recognised even if the documents are significantly crumpled, damaged or perforated.

[Reply Card No. E283]

Storage Racks

A DESIGN of storage rack built up of simple standard units and which can readily be adapted to meet a variety of requirements, has been introduced under the trade name of "Simplock" by H. T. and M. Construction, Ltd., Hanbury Road, Stoke Prior, Bromsgrove. This system is based upon square tubular steel columns which are slotted on opposite sides to support cantilevered arms, as shown in the diagram we reproduce. The channel section arms each have two locating and support tongues projecting from one end. When an arm is inclined at an angle, its two tongues can be passed through a pair of slots in a column, and when the arm is then lowered into a horizontal position it is firmly supported by the tongues.



Slotted column and adjustable cantilever arm of standard unit storage rack

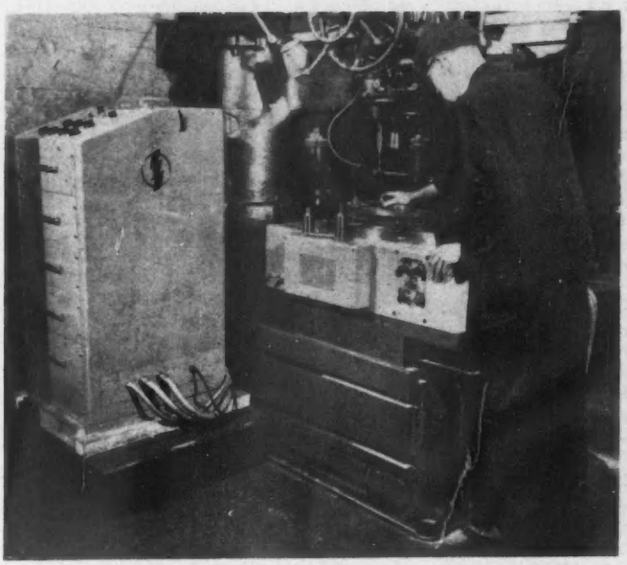
The arms are available in five standard lengths, from 12in to 24in, and the spacing of the slots at 4$\frac{1}{16}$in centres up the column enables the distance between them to be selected in accordance with storage requirements. The columns are available in heights up to 8ft 3½in and each has a foot extending at right angles at its lower end. The two columns needed to build up each rack section are braced firmly together by two horizontal cross members and diagonal straps. A "U" piece forming a square slot is welded on each side at each end of the rack arms. Projecting from brackets which are fitted into these slots are radial spigots through which there are supported a pair of tubes extending between the arms across the width of the rack section. These tubular members are used to support continuous shelves of sheet metal or mesh available in various forms to suit the class of goods to be stored. Alternatively, flat shelves of sheet metal construction can be fitted between the arms and two forms of these shelves incorporate spacers or compartments for sliding sheet metal drawers.

The makers point out that with this design of shelving, an initial single or double-sided installation can be readily extended or dismantled and repositioned as required. The standard arm and shelf members can be spaced at any required heights on the columns to suit a variety of sizes and shapes of stores and the spacing quickly altered to accommodate changes in classes of goods handled. This design of shelving has also been adopted by the makers for fitting on a mobile castor-mounted trolley on which full use can be made of the adjustable shelf spacing to adapt the unit for different applications in an industrial establishment.

[Reply Card No. E284]

Electronically-Controlled Rotary Machine Table

A NOTE received from E.M.I. Electronics, Ltd., Hayes, Middlesex, states that an electronically controlled positioning system has been applied to a rotary machine table in collaboration with Optical Measuring Tools, Ltd. One of these 30in tables which has been in use at the Rolls-Royce works for some months is shown in our illustration. This design of table



Rotary table with an accuracy of ±3 seconds of arc being used on a radial drilling machine

rotates at a speed of 1½ r.p.m. and its setting accuracy is claimed to be better than ±3 seconds of arc.

In the automatic positioning system an inductor measuring element indicates the position of the table itself and not merely the position of the worm drive or lead screw, so that the degree of accuracy is unaffected by mechanical wear or variations. For batch production means of punched tape table control can be used. In this case a programme of angular settings is punched into a tape used for feeding the information into a reader on the control console. Thereafter either continuous or intermittent table operation can be used. In non-continuous operation, the operator presses the start button and the table moves to the first position, where it is automatically clamped, for the first machining operation to be performed. For each successive setting the operator presses the button to start another cycle of operations. In continuous operation, all table movements are automatically controlled by the punched tape, and the operator only has to fix the workpiece to the table and press the start button once.

When making prototype or one-off work pieces, a control tape is not required, and for this purpose the positioning system incorporates dial controls, which can easily be set for any required angular settings of the table, without loss of accuracy. In all cases, the table rotates the shortest way round to the next position, either clockwise or anti-clockwise, thus saving time on a job when several holes are required to be drilled.

(Reply Card No. E291)

Aircraft Inverter Tester

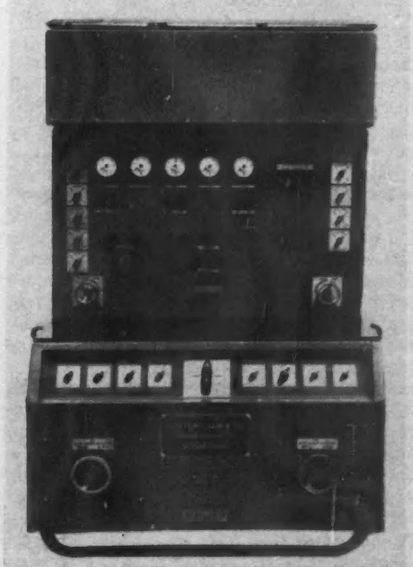
DEVELOPMENT of the inverter tester manufactured by Arthur Lyon and Co. (Engineers), Ltd., 6, Carlos Place, Grosvenor Square, London, W.1, from the original Air Ministry specification has led to the production of the Mark III version illustrated. This equipment is used to test rotary inverters or frequency converters installed in aircraft during periods of overhaul, and authority has been given for general manufacture and export to the British Commonwealth (excluding Hong Kong) and the North Atlantic countries. The tester in its latest form, as illustrated, incorporates control resistances for the inputs to the machines under test and also provides facilities for the testing of frequency converters which were not available in earlier models.

External d.c. supplies at 28V and 115V are required for operating inverters and may be connected permanently to the tester, being selected by means of a switch. A double-range voltmeter and triple-range ammeter are fitted for checking the inputs, which are adjustable by means of series resistors controlled by the hand-wheels on the front bottom section of the panel.

Three-phase and single-phase loading mats consisting of fixed resistances with tapping lugs for load selection are mounted vertically in the base of the tester. A screw-motion variable resistor is associated with each mat. Two moving iron instruments—a voltmeter and ammeter—are fitted for output readings. Below the tester table a voltmeter switch is provided for reading the line voltage of any pair of the three-phase lines and an ammeter switch with current transformer enables the amperage to be read over either single- or three-phase loads or alternatively in any one of the three-phase lines.

For the testing of frequency converters the same measuring equipment is used on the load side as with inverters, but on the input side a three-phase voltage regulator is fitted comprising a Zenith "Variac" transformer feeding the primary of a fixed ratio double-wound transformer. A 400 c/s ammeter and voltmeter are fitted for metering the input, which must be taken from a separate a.c. supply of appropriate voltage and frequency.

Approximate overall dimensions of the tester are 6ft high, 2ft 6in wide and 2ft 6in deep, and the weight is approximately 228 lb.

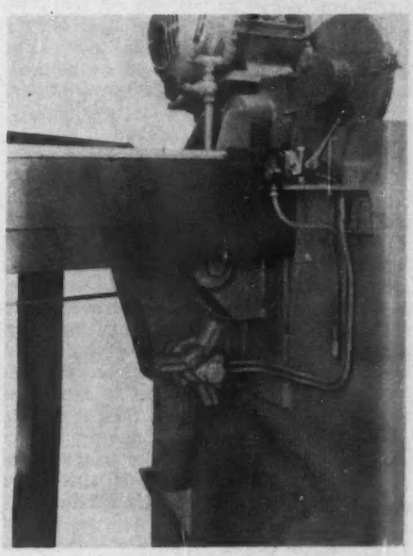


Test equipment with loading mats and metering for testing aircraft inverters and frequency converters

[Reply Card No. E292]

Air-Operated Bar Feed Mechanism

AN automatic cut-off machine which has an air-motor-driven bar feed mechanism has been developed by S. Russell and Sons, Ltd., of Leicester, for cutting stock into small pieces for feeding into hot brass presses. The bar is fed to the saw by a small bogie hauled along the stock channel by a cable over pulleys driven by a ⅛ h.p. radial air motor supplied by the Globe Pneumatic Engineering Company, Ltd., Harold Hill, Romford, Essex. The motor can be



Air motor for continuously driving feed bogie cable on automatic bar cutting-off machine

seen in position in the accompanying illustration.

During the cutting operation the bar and motor are stalled by the gripping of the bar by an automatic vice on the machine. Upon release of the vice jaws the air motor continues to feed the bar through the jaws without recourse to operation of valves or switches. No damage occurs to the motor as a result of stalling during this continuous stopping and starting cycle. When the bar has been completely fed through, the air motor drive is reversed to return the bogie to the starting position where trip switches are actuated to allow a fresh bar to be loaded.

[Reply Card No. E293]

Corrosion of Boiler Tubes

A PAPER with the title "The Corrosion of Welded or Coated Mild-Steel and of Wrought-Iron Boiler Tubes in Highly Saline Water" was presented by G. Butler, M.A., Ph.D., and H. C. K. Ison on December 11 to the North East Coast Institution of Engineers and Shipbuilders. The paper describes an investigation in collaboration with the British Shipbuilding Research Association on the corrosion of electrical-resistance welded and of coated seamless steel tubes in sea-water using model fire-tube boilers. Welded tubes are stated to be susceptible to deep pitting and perforation, particularly in the weld region, and, in contrast to previous results with seamless tubes, this is not reduced by increasing the copper content of the steel. The possible reasons for this difference in behaviour are discussed. The corrosion of mild-steel tubes is noted as being markedly reduced by chromising or phosphating but not by aluminising or aluminium spraying; no pitting was observed on chromised tubes but these tubes had unsuitable mechanical properties, having a tendency to split on expansion into the tube plates. Furthermore there is evidence that the protection afforded by phosphating is of a temporary nature. No wrought-iron tubes were available for experiment but several tubes with a long service life were examined and the reasons for this extended life are discussed.

INDUSTRIAL NEWS

European Free Trade Association

On Tuesday, the Outer Seven European Free Trade Association convention was signed, on behalf of the United Kingdom Government, by the Chancellor of the Exchequer and the President of the Board of Trade. The convention, it will be recalled, was initialled on November 20 by Ministers of the seven consenting countries, namely, the United Kingdom, Norway, Sweden, Denmark, Portugal, Switzerland and Austria. When all the countries have signed, the convention is to be submitted to their parliaments for ratification.

The information division of the Treasury has recently issued a special bulletin for industry, setting out the text of the convention and up-to-date statistical information as to the trade of the seven participating countries. The bulletin also comments on the prospect for the "seven," saying that the countries involved see great possibilities of expansion through the establishment of their free trade association. With only half the population of the European Economic Community (E.E.C.) group, the E.F.T.A. countries have a gross national product nearly two-thirds as big. Even more important for the United Kingdom, the continental E.F.T.A. countries have exceptionally high imports in relation to their gross national products, which indicates, of course, that the market potential is good for United Kingdom exports. Already a tenth of this country's exports goes to its E.F.T.A. associates, providing one-eighth of their total imports.

The bulletin adds that the hope of all the "Seven" is that the quick establishment of their group will bring about the conditions in which the two bodies, the "Seven" and the "Six" can come together. This prospect, it is stated, has been a source of encouragement to the industrialists and trade unionists of the seven countries. In the United Kingdom about 70 per cent of the trade associations canvassed by the Federation of British Industries positively favoured the plan and more than half the rest were ready to accept it. So, the bulletin observes, "with varying degrees of enthusiasm, almost 90 per cent of the industrialists consulted are behind the plan, believing it to hold out the best hope of a wider O.E.E.C. arrangement for the development of Western European trade and production." With the same object in mind, trade union representatives of the United Kingdom, Scandinavia, Austria and Switzerland have welcomed the European Free Trade Association, attaching particular importance to the inclusion of full employment among its aims.

T.U.C. and a Shorter Working Week

The general council of the Trades Union Congress has issued a statement about the progress being made towards the achievement of a shorter working week in industry. It will be recalled that at the annual assembly of the T.U.C. at Blackpool in September, a resolution was carried requesting the general council "to inform the Government, industrialists and all employers of its grave concern in this pressing problem and of its intention to seek ways and means to reduce the weekly hours of labour." In recent months a shorter working week, without loss of pay, has been negotiated in various industries, notably in printing, electricity supply, flour milling, petrol and fuel oil distribution and chemicals, the reduction generally being from forty-four to forty-two hours. Claims for a shorter working week are still outstanding in the engineering, shipbuilding and coal mining industries.

The T.U.C. statement observes that a movement towards a shorter working week is well under way in most other countries in Western Europe and in the U.S.A. In Germany, the statement adds, the normal working week has been reduced by about three hours since 1956, while in Sweden weekly maximum hours of work are to be reduced by three hours in 1960. A similar programme, the T.U.C. says, has been introduced in Norway. After pointing out that in France there is a standard working week of forty hours, by law, and that in many other countries normal working hours are forty or less, the statement complains that "until recently the United Kingdom had not shared in this development." Indeed, the T.U.C. remarks, the last general reduction in hours of work was as long ago as 1946–47.

The T.U.C. statement goes on to say that, since 1948, overall productivity has risen by about one-fifth, but in that period there has been little reduction of normal hours of work. Productivity, the T.U.C. asserts, is continuing to rise. If a reasonable share of this increased productivity is to be taken by workpeople in the form of increased leisure, it is necessary, the T.U.C. suggests, periodically to take stock of the position and to make the general reduction of hours which is commensurate with technical progress. The way in which some increases are to be shared out, the statement observes, "is a matter which can only be dealt with through the normal negotiating machinery."

Master Schedule of Steel Standards

The British Standards Institution has recently published the first part of a new "Master Schedule of Wrought Steels" (B.S. 3141). This part is concerned with carbon steels; subsequent parts of the schedule will deal with: (*a*) alloy steels with specified chemical composition; and (*b*) steels with specified mechanical properties but without detailed chemical composition.

The B.S.I. has pointed out that, over the years, a great many standards for steel have been published to meet the demands of industry and that there are now, in fact, over 100 standards covering steel as a material. Many of these standards themselves contain several separate specifications for different grades of steel, one of the most widely used, B.S. 970, containing detailed specifications of over 100 wrought carbon and alloy steels for automobile and general engineering purposes. A great many of the steels to these specifications differ from one another only very slightly but, because each is to a recognised British Standard grade, steel producers are expected to supply any and every kind. In the past, in the major steel-using industries, new kinds of steel have been specified somewhat haphazardly according to the requirements of designers; these specifications, hallowed by time and tradition, have gradually found their way into the pages of British Standards. Moreover, there has been a tendency for the B.S.I. to publish separate steel standards for different groups of users, such as the aircraft, automobile, chemical and petroleum and railway engineering industries.

Thus, there exists in the steel industry a needless and uneconomic diversity of output which standards have not been able to control. With the publication of this new schedule, the British Standards Institution, in collaboration with the steel industry and user-interests, has taken a step towards ending an unsatisfactory state of affairs.

Laid-up Shipping

The latest statement issued by the Chamber of Shipping of the United Kingdom indicates that the total of British ships laid up in home ports on December 1, for reasons other than repair, amounted to 135 ships of 823,050 tons gross, including fifty-three oil tankers of 460,066 tons. The total compares with 180 ships of 1,024,109 tons on October 1 and 160 ships of 978,453 tons on November 1. Ships awaiting or undergoing repair totalled fifty-six of 331,758 tons, including thirteen tankers of 112,672 tons.

Barton High Level Bridge

The main contractor for the Barton high level bridge, G. Dew and Co., Ltd., regretfully announced last week that it had been found necessary to terminate the employment of Samuel Butler and Co., Ltd., as the sub-contractor for the supply and erection of the structural steelwork. In a statement setting out the circumstances which necessitated this action, it is pointed out that the sub-structure for the bridge was completed twelve months ago. The steelwork erection was started in April, 1958, but from the outset progress has been handicapped by "go slow" action and strikes by the employees of Butler and Co., Ltd. The slow progress, the statement continues, was further aggravated by an unfortunate accident suffered by Butler and Co., Ltd., last February, when a temporary steel tower erected by another sub-contractor collapsed. Acknowledgment is made of the efforts put forward by Butler and Co., Ltd., in an endeavour to recover lost time, by augmenting the resources of plant and labour on the site. But, unfortunately, the industrial disputes with Butler's employees continued.

The steelwork erection is six months behind programme and Butler and Co., Ltd., was asked for a guarantee that the work would be completed by the end of this month in order that the bridge might be finished by the required date. In an attempt to meet the requirement, Butler and Co., Ltd., tried to negotiate a payment to the employees for completion in six weeks. The firm was not in a position, however, to meet the sum finally demanded by its employees and could, consequently, give no estimate of the time needed for finishing the job. As G. Dew and Co., Ltd., felt that it would be unfair to discharge the sixty or so of its own employees who are rendered more or less idle until the steelwork is completed, there was no alternative, the statement says, but to terminate the employment of Samuel Butler and Co., Ltd., and to make other arrangements for the completion of the steelwork so that the bridge might be ready by the required date.

PERSONAL AND BUSINESS

Appointments

DR. W. G. HISCOCK has been appointed chairman of the Lead Development Association for 1960.

MR. BRIAN P. YATES has been elected to the board of directors of Low Moor Alloy Steelworks, Ltd.

SIR OWEN WANSBROUGH-JONES has been appointed a director of The British Oxygen Company, Ltd.

MR. A. B. HARMAN, A.M.I.C.E., has been appointed secretary of the Reinforced Concrete Association.

MR. R. T. W. ANDERSON, M.I.E.E., has been appointed district manager at the Birmingham works of British Electrical Repairs, Ltd.

MR. A. H. STAFFORD has been appointed secretary of the eastern, London and south-eastern region of the Central Electricity Generating Board.

MR. C. ATKINS has been appointed sales manager of The Wardle Engineering Company, Ltd., in succession to Mr. J. H. Gordon who has retired.

MR. HENRY WOOLDRIDGE nas been appointed director of the Forest Products Research Laboratory to succeed Dr. F. Y. Henderson, who retires next October.

VERO PRECISION ENGINEERING, Ltd., has announced that Mr. Albert J. Silk, Mr. Wilfred H. Guy and Mr. George F. Day have been appointed directors.

THE ADMIRALTY has announced the appointment of Mr. P. T. Williams to be director of Navy contracts in succession to Mr. B. Pool who is retiring. The appointment takes effect from February 1.

HOPKINSONS, Ltd., announces that Mr. G. M. Wells, sales director, has been appointed assistant managing director. Mr. J. A. Fuller has been appointed chief engineer in succession to Mr. G. Sewell.

MR. ARTHUR GEOFFREY BERRY has joined the industrial sales force of Mullard, Ltd., as representative for the area comprising Oxfordshire, Buckinghamshire, Middlesex and the London N.W. postal districts.

CABLE AND WIRELESS, Ltd., announces that Mr. G. W. T. King has been appointed contracts manager in succession to Mr. R. C. F. Saxby who has retired. Mr. S. W. Austin has succeeded Mr. King as assistant contracts manager.

DOWTY GROUP, Ltd., announces that the board of directors of Dowty Marine, Ltd., is as follows : Sir George Dowty, chairman ; Mr. R. F. Hunt ; Mr. Donald Campbell ; Mr. L. S. Flatman, general manager ; and Mr. C. J. Luby.

THE METAL INDUSTRIES GROUP announces that Mr. J. H. Rawlings has relinquished the position of managing director of Avo, Ltd., but remains on the board of the company as deputy chairman, and also on the board of Brookhirst Igranic, Ltd. Mr. S. R. Wilkins has succeeded Mr. Rawlings as managing director of Avo, Ltd. Mr. E. Strauss has been appointed director and general manager of Taylor Electrical Instruments, Ltd. Mr. Strauss has joined the Avo board and Mr. Wilkins has joined the board of Taylors.

Business Announcements

THE HUGHES BOLCKOW SHIPBUILDING COMPANY, Ltd., of Blyth, Northumberland, a Metal Industries Group subsidiary, has changed its name to Hughes Bolckow, Ltd.

HAWKER SIDDELEY GROUP, Ltd., and DE HAVILLAND HOLDINGS, Ltd., announce that following discussions they have agreed to recommend a merger of the two companies.

UDDEHOLM, Ltd., Crown Works, Northwood Street, Birmingham, 3, states that its precision tool treatment division is prepared to undertake the heat treatment of tool steel other than its own.

THE BIRMINGHAM TOOL AND GAUGE COMPANY, Ltd., Soho Hill, Birmingham, 19, has secured the sole distribution rights for the electromagnetic bench production tools manufactured by Black and Webster, Ltd., Massachusetts, U.S.A.

ABELSON AND CO. (ENGINEERS), Ltd., Coventry Road, Sheldon, Birmingham, 26, states that it has signed an agreement with Ruston Bucyrus, Ltd., by which Ruston Bucyrus, Ltd., are to manufacture "Buildmaster" cranes under licence.

THE MOTOPLAS COMPANY, Ltd., is to move from Armoury Road, Small Heath, Birmingham, 11, to Waverley Works, Coventry Road, Birmingham, 10, with effect from January 4, 1960. The telephone number, Victoria 1008, remains unchanged.

J. STEAD AND CO., Ltd., of Sheffield, announces that, in order to simplify administration and achieve better distribution, all tools manufactured by the Darwins Group are to be concentrated into one section known as the Darwins Tool Division (J. Stead and Co., Ltd., Manor Works, Sheffield, 2). In addition, "Steadfast" will be the brand name for all tools manufactured by the Darwins Tool Division.

THE BIRMINGHAM TOOL AND GAUGE COMPANY, Ltd., and NORTH WEST MACHINE DESIGN COMPANY, Ltd., have formed a joint subsidiary company, Production Machines, Ltd., 177, Kenton Road, Kenton, Middlesex, for the design and manufacture of special purpose machines and equipment. The directors of Production Machines, Ltd., are Mr. G. D. Bond, chairman ; Mr. E. A. Cartner, managing director ; Mr. D. W. Butchart, production ; Mr. C. V. White, design, with Mr. R. J. Perry, alternate.

Contracts

SHORT BROTHERS AND HARLAND have received from the Swedish Admiralty an order for an evaluation quantity of "Seacat" ship-to-air guided missiles.

Miscellanea

BY-PASS TURBO-JET.—The first run took place in late 1959 of the Rolls-Royce RB.141 by-pass turbo-jet, an engine of 15,000 lb thrust based on the "Conway" and described as the first of the second generation of Rolls-Royce by-pass jets. Provision for mixing the cold and hot flows is expected to improve the specific fuel consumption at least 2 per cent.

MOBILE A.C. WELDING SET.—A lightweight mobile a.c. welding set is now made by Welding Industries, Ltd., Blackswarth Road, Bristol, 5. In this plant a Petter P.C.3 diesel engine drives a medium frequency alternator at 3000 r.p.m., giving a frequency of 450 cycles. The welding range of 20A to 250A enables operation with electrodes from 16 to 4 S.W.G. A power take-off provided on the set can be used for driving a grinding disc through a flexible shaft.

MILLING CUTTER WITH "THROW AWAY" TIPS.—A milling cutter with "throw away" tips developed by Edibrac, Ltd., Broadheath, Manchester, is designed to eliminate the need for tool setting and regrinding. This "Centralok" cutter is fitted with eight tungsten carbide inserts, each of which has four cutting edges on either side. By a simple indexing and reversing operation on each insert the eight cutting edges can be used in turn. When a new cutting edge is brought into use it is automatically aligned with all other edges when the insert is relocked on the head.

OIL WALL MAP.—The Petroleum Information Bureau, 29, New Bond Street, London, W.1, has published the 1959 edition of its wall map indicating the relative importance of the world's oil producing and refining countries and including statistics for 1958. The estimated world crude oil production and refining capacity for 1958 is given as 938,290,000 and 1,081,750,000 metric tons, respectively. Production in metric tons for the major countries is as follows : U.S.A.—360,670,000 ; Venezuela—137,540,000 ; U.S.S.R.—113,500,000 ; Kuwait—70,220,000 ; Saudi Arabia—50,000,000 ; Persia—40,420,000, and Iraq 35,690,000.

SELF PRIMING PUMP.—A vertical self priming unit has been introduced by Precision Electrical Products (Stockport), Ltd., Gale Green, Stockport, for general purpose pumping duties handling liquids up to 220 deg. Fah., including fuel, diesel and other oils up to 450 seconds Redwood No. 1, as well as volatile liquids. The pump has a suction lift of 28ft when handling cold liquids, the capacities and heads being 70 g.p.h. at 100ft and 400 g.p.h. at 25ft. The pump casing is so arranged that if the foot valve on the suction line should be inoperative the pump will continue to work. The impeller is specially shaped and fitted with very short blades and does not contact at any point witn the casing. The pump and motor shafts are rigidly coupled and the drive can be from a ½ h.p. three-phase motor, although either single-phase a.c. or d.c. motors can be fitted if required.

FATIGUE OF WELDED STRUCTURES.—A symposium on fatigue of welded structures organised jointly by the British Welding Research Association and the Engineering Department, Cambridge University, is to be held in the Engineering Department, Cambridge University, from Tuesday, March 29, until Friday, April 1, 1960. Several papers will be presented by experts and will include contributions from the United States of America and from East Germany. These papers will deal primarily with structures fabricated by fusion welding processes. The fee for membership of the symposium is fifteen guineas; and further particulars may be obtained from the British Welding Research Association, Abington Hall, Abington, Cambs.

HOME WORKSHOP POWER EQUIPMENT.—A home workshop power equipment based upon an electric drill has been introduced by the Revo Electric Company, Ltd., of Tipton, Staffs. The drill is fitted with a ⅜in capacity, three-jaw chuck and has a rated power input of 350W giving an unloaded spindle speed of 3000 r.p.m. and a fully loaded speed of 1800 r.p.m. During running the motor is continuously cooled by an impeller with twenty-four blades. Ancillary equipment available for use with the motor includes a bench holder ; a drill arm clamp ; a drilling table ; a lathe kit ; a sander ; a sander/saw table ; a circular saw and grinding, buffing, polishing and sanding attachments. A spirit level is built into the drill body to facilitate horizontal drilling operations, and a double-hand grip gives ease of control.

IMPACT OF NUCLEAR DEVELOPMENT ON ELECTRICITY SUPPLY AND INSTRUMENT TECHNIQUES.—The Institution of Electrical Engineers, Savoy Place, London, W.C.2, is organising a Convention "on the impact of nuclear development on electricity supply and on instrument techniques," to be held in London in September, 1961. Among the subjects to be discussed will be present and future energy requirements in relation to energy resources available ; economics ; operating characteristics ; the siting of nuclear power stations and its effect on system planning ; health physics ; radiation detectors ; pulse circuits ; nuclear measuring instruments for research, processing control, and for prospecting and mining applications ; instruments for nuclear reactors and associated plants ; and data processing for nuclear applications. It is proposed that visits of technical interest will be associated with this convention. The organising committee invites offers of papers for consideration for inclusion in the Convention.

VIBRATORY CONVEYOR.—A vibratory conveyor developed by Sinex Engineering Company, Ltd., of North Feltham Trading Estate, Feltham, Middlesex, is particularly adaptable for installation where very little headroom is available and the simple transfer of material is required from one point to another. The feed of the conveyor can be stopped or started at will and although the speed of travel remains constant the level of material can be altered by a gate to control the amount being fed. The conveyors can be supplied in lengths to suit users' requirements. Each conveyor comprises a feed trough fitted with a pair of "Sinex" electric vibrators, one on each side of the trough. These vibrators are mounted with their shafts in a vertical plane but inclined at a specific angle to provide a feed of material in one direction along the trough. The only moving parts employed are the rotors of the vibrators and when necessary vibrators can be quickly replaced on the lug mountings on which they are held by four bolts.

FILMSTRIPS FOR STUDENT ELECTRONICS ENGINEERS.—The Mullard Educational Service has announced the introduction of a new series of filmstrips designed to assist the teaching of electronic engineering in technical colleges, services training establishments, industrial apprenticeship courses, &c. The first of the series "Thermionic Oscillators," which comprises twenty-seven colour frames, arranged in two parts, is now available from the distributors, Unicorn Head Visual Aids, Ltd., 42, Westminster Palace Gardens, London, S.W.1, price 25s. a copy, including comprehensive teaching notes. Part one explains the basic principles of electronic oscillation, part two continues with explanations of Miller-effect, electron-coupled and crystal-controlled oscillators, and the strip concludes with an examination of a typical practical circuit comprising oscillator, buffer amplifier and output amplifier. The second filmstrip in the series, now in preparation, deals with non-sinusoidal oscillators. This will be followed by others covering the subjects of modulation and transmission.

CONTINENTAL AFFAIRS

by Our Continental Editor

Mangfall Bridge

AN unusual work of bridge construction is being carried out near Weyarn (Bavaria) where the Munich–Salzburg autobahn crosses the valley of the Mangfall at a height of about 70m. At this place stood one of the most important prewar bridges, a plate girder bridge over three spans of 90m, 108m, and 90m with superposed concrete road deck of full autobahn width of 23·50m. This bridge was destroyed in 1945, and subsequently a temporary bridge was constructed using army bridging equipment. This was only 11·40m wide and constituted a serious traffic bottleneck on a motorway which eventually carried up to 20,000 vehicles per day. After several catastrophic accidents, a decision was taken in 1957 to replace the temporary bridge with a new full-width construction. The choice fell upon a design in prestressed concrete evolved by Dyckerhoff and Widmann K.G., Munich, comprising two 6·61m high lattice girders with 5·91m long elements, as illustrated in Fig. 1. The top flange is formed by the prestressed deck of 23·50m overall width which is cantilevered on either side of each girder, the two halves being joined by a central rib. The lower flanges are also combined so as to form a lower deck which will be used as a cycle- and foot-path. An excellent view of the valley and surrounding hills will be obtained through the openings of the lattice girders and the oval cut-outs in the centre of the lower deck.

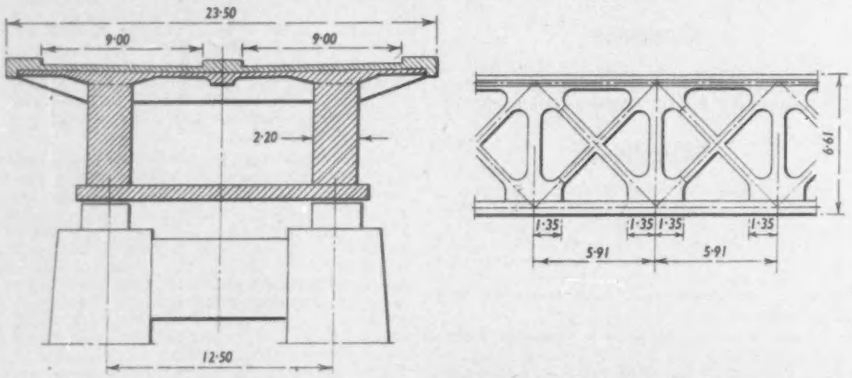


Fig. 1—Sectional view of Mangfall Bridge and (right) prestressed concrete lattice girder

The two motorway carriageways will each be 10·5m wide with a 2m wide raised central reservation and will be protected on the outside by 50cm high guard rails.

As it was not possible to interrupt traffic during the two-year construction period, or to divert it to the steep and narrow local roads, it became necessary to move the old bridge laterally on to temporary piers, which meant an interruption of only about three weeks. Considering the height and length of the steelwork and the weight involved, this operation was the most difficult part of the whole scheme; the 288m long bridge, weighing approximately 4000 tons, had to be shifted parallel to itself 18·34m to the south, so as to enable the original piers and abutments to be re-used and the former line of the autobahn to be maintained. For this purpose a number of auxiliary piers were constructed in the form of hollow concrete columns of 3m diameter and 0·25m wall thickness, each capable of carrying 1100 tons. These were built during the winter of 1957–58, in temperatures reaching −19 deg. Cent. Sliding shuttering enabled a rate of progress of 6m per day to be maintained. Next, steel tracks were installed from under the existing bridge to the auxiliary piers and abutments and, finally, the bridge was transferred by means of six 200-ton hydraulic presses. Fig. 2 shows the temporary bridge before its transfer. The method required lifting the bridge by 1·03m by means of hydraulic jacks and putting in slider plates which were chosen in preference to rollers. Although these plates were machined, it was considered prohibitive also to machine the flanges of the girders which served as tracks; these were merely flame-scaled and wire-brushed to remove rust. The question of an effective lubricant was an important one, since the dead load corresponded to 1600 tons per pier, or 800 tons per slider, equivalent to an average of about 100 kg per square centimetre, which through unevenness in the surface might be substantially exceeded locally. Experiments were therefore carried out with a mineral grease with colloidal graphite added, and with molybdenum disulphide. The latter was used in two forms, either as "Molycote G," a highly concentrated powder, at the rate of 20 grammes per square metre, or as "Molycote K," a greasy paste, which was applied at the rate of 50 grammes per square metre. Tests carried out with a 500-ton press using pressures up to 190 kg per square centimetre gave coefficients of friction ranging from 0·245 to 0·35 (average, 0·28) for graphite grease, and 0·15 to 0·18 (average, 0·165) for molybdenum bisulphide paste, while dry surfaces gave values of from 0·445 to 0·53 (average, 0·477). These results led to a decision to use molybdenum bisulphide lubricant and during the subsequent operation coefficients of 0·08 to 0·13 were observed. This part of the work was carried out by Süddeutsche Eisenbau G.m.b.H., Nuremburg.*

The concrete bridge, which, it is anticipated, will be completed by this summer, is being built from the Munich end partly as a free cantilever, using auxiliary temporary piers, some of which may be seen in Fig. 2; these are of concrete and similar to those described above. The maximum free cantilever is 58m. Construction is in forty-eight stages, at the rate of 6m per week, using a special carriage which carries the shuttering. The superstructure is scheduled to be completed in twenty months and requires 5800 cubic metres of concrete, 2000 tons cement and 1000 tonnes of steel. Finally, the steel bridge and temporary piers are to be removed. The total cost is estimated at DM.6,500,000.

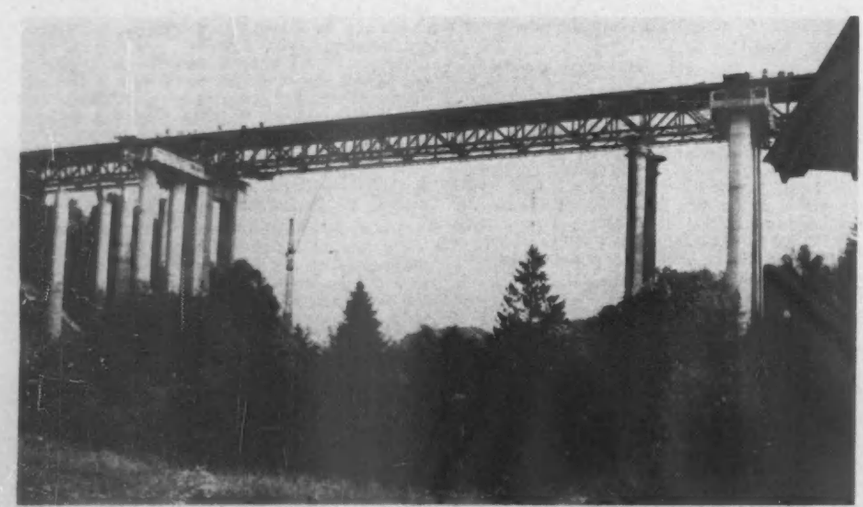


Fig. 2—The 11·4m wide, 4000-ton temporary steel bridge over the Mangfall, prior to its being shifted on to auxiliary piers. Also seen are three groups of temporary piers for the subsequent support of the new concrete bridge during cantilever construction, proceeding from left to right

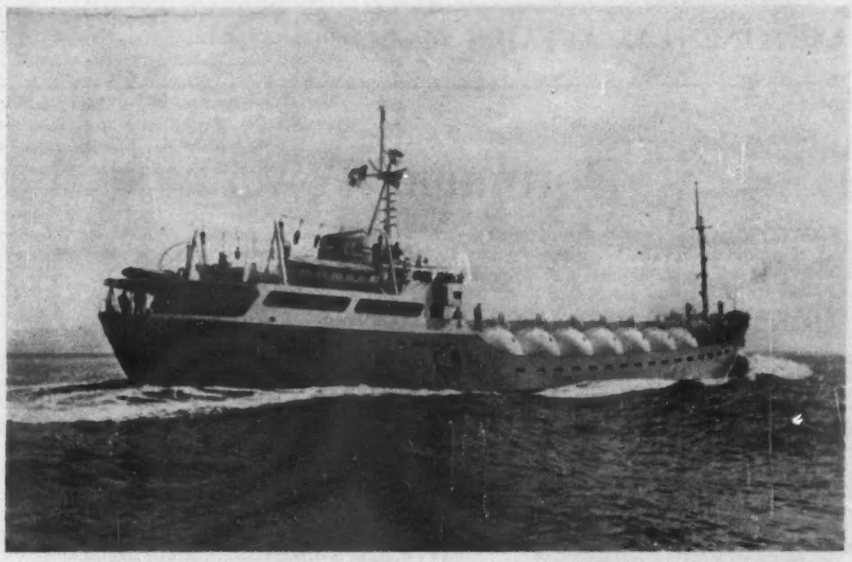
Novosibirsk Power Station

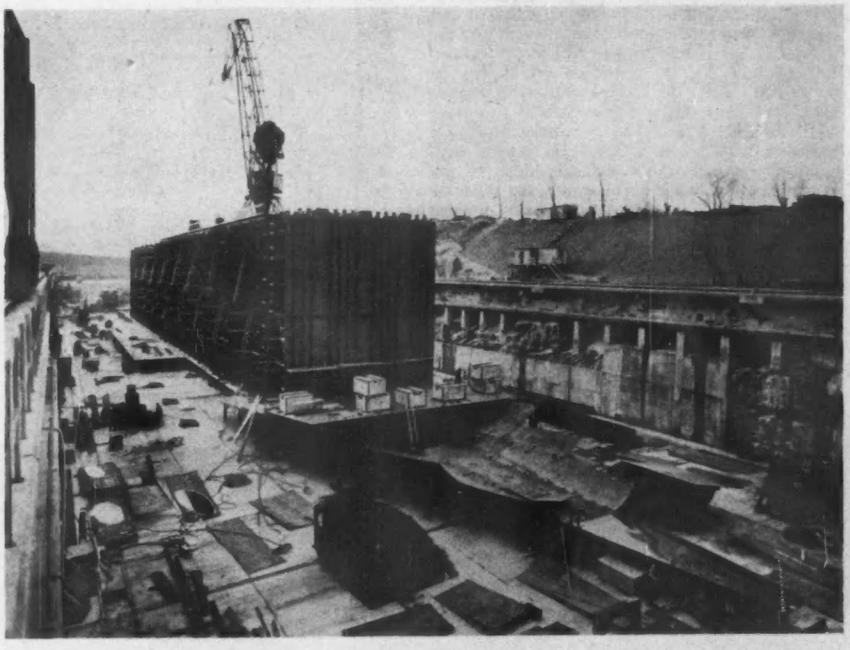
The last of the seven turbo-generators of the Novosibirsk Hydro-Power Station on the River Ob went into operation last year, raising its capacity to the planned level of some 400MW. Since the station first began operating in 1957, nearly 1000 million kilowatt hours of electricity have been generated.

* *Le Genie Civil*, April 15, 1959, page 173

Continental Shipping

While pipelines may one day carry North African natural gas across the Mediterranean, transport by tanker has already proved its feasibility, and at the same time appears to be the more flexible method. The "Agipgas Terza" (TOP), the largest gas tanker so far built in Europe, was delivered by the shipyards M. & B. Benetti of Viareggio. It displaces 1386 tons deadweight and can carry 730 to 950 tons of liquefied petroleum gas. For this purpose there are installed on the main deck eighteen cylindrical, hemispherically-ended tanks of 4200mm inside diameter, two of which are 9015mm long, and the rest 4200mm. These are designed for a working pressure of 18 atmospheres, and hold a total of 1730 cubic metres. The main load lines are served by three 40 cubic metres per hour vertical compressors, and two 50 cubic metres per hour centrifugal pumps, separated from their electric motors by gastight bulkheads. A centralised gas alarm and CO_2 system are installed. The ship is powered by an 1890 b.h.p. "M.A.N." diesel engine and does 13·8 knots.





The latest facility particularly for the construction of large tankers is the new drydock of Eriksbergs Mekaniska Verkstads AB, Gothenburg, for units up to 100,000 tons deadweight (LEFT). On September 1, prefabricated keel units of the first vessel, a 48,600-ton tanker, were laid down. Simultaneously, the floating dock gate is being constructed behind the dam before this is cut away. The dock is 280m long and 44m broad, and is served by three (later four) 60-ton cranes. Only a fortnight after its completion early in April, the first vessel will be launched. The "Olivier van Noort" (BELOW), one of a growing number of pusher tugs on the Rhine, was built by L. Smit & Zoon at Kinderdijk. The 36·15m long vessel is powered by two 750 h.p. "Bolnes" diesels and equipped with electro-hydraulic winches, "Decca" Rhine radar with bend indicator, wireless telephony and loud-hailer. Two normal and four flanking rudders are actuated by a "Stork-Jaffa" electro-hydraulic steering gear. The tug pushes upstream four barges of over 1500 tons each, while on the return trip two are pushed and two lashed alongside.

CONTINENTAL AFFAIRS *(Continued)*

Dortmund Tower

FOLLOWING the construction of the Stuttgart television tower (THE ENGINEER, January 13, 1956, page 64), a certain spirit of competition appears to have arisen among the larger towns of Germany and neighbouring countries, who are vying with one another in the erection of similar structures. Examples are the Rotterdam "Euromast" (Plate 16) and the Dortmund observation and telecommunications tower.

The Dortmund Tower, at present the highest tower structure in Germany, was erected in the period May 22, 1958 to April 30, 1959, the immediate occasion being last year's Federal Garden Exhibition which was held throughout the spring and summer. Our illustration (Fig. 1) shows the structure which comprises principally a reinforced concrete cylinder of 173·45m height, tapering from an outside diameter of 11·74m at ground level to 5·50m at a height of 133·2m.

The foundation extends to −8·10m and consists of a circular concrete footing 25m in diameter which at the centre is 2·5m thick.

The tower carries two sets of balconies, the lower, larger one between the levels 133·2m and 144·7m, while the upper platforms extend from 151·8m to 155·5m. The principal data are listed in Table I.

Fig. 1—Observation and telecommunications tower

TABLE I—*Principal Data of Dortmund Tower*

Overall height, metres	219·60
Total height of concrete tower, metres	173·45
Depth of foundations, metres	8·30
Diameter of foundation slab, metres	27·00
Diameter of concrete shaft :	
At ground level, metres	11·74
At and above 133·20m level, metres	5·50
Wall thickness :	
At ground level, metres	0·51
At and above 133·20m level, metres	0·20
Levels :	
Restaurant, metres	137·60
Observation platform, metres	142·0
Telecommunications equipment, metres	151·70
Installed electrical capacity, total, kVA	500
Lift speed, metres per second	4
Lift capacity (two lifts), persons per hour	480
Total weight of tower, tonnes	7700

The lower balcony has a maximum diameter of about 14·74m and comprises two interior levels, the upper one at 137·6m serving as a restaurant for 100 people, while the lower level at 133·2m is used for the kitchen and offices. This part of the tower, shown in section in Fig. 2, rests on a cantilevered ring. The roof forms an observation platform for 200 persons.

While the main structure is carried out in concrete, the restaurant floor at 137·6m level and its glazed outer wall are a steel structure supported on rollers in such a way that it can be slowly rotated by an electric drive. For the choice of this arrangement several considerations were responsible, the principal one being, of course, to enable the full panorama to be seen from each table. It is, however, also important to maintain an even temperature inside the restaurant. This is difficult on sunny days when the side towards the sun tends to get unbearably hot, while in the winter, the shadowy side may easily lose too much heat through radiation through the windows. With rotating floor and windows these adverse effects are diminished or disappear entirely. Another point which is of benefit is that the tendency of the glass to deform under thermal stress is reduced. An 8 h.p. electric motor driving through a steplessly variable gear allows speeds between 2 r.p.h. and 6 r.p.h.

In the upper balcony, 151·7m above ground level, equipment for a directional telecommunications link is installed, while above, on the remaining 17·2m-high concrete section, the horn and parabolic aerials are arranged. The concrete tower is surmounted by two aerial masts for television broadcasting, one above the other, which have a combined height of 46·15m.

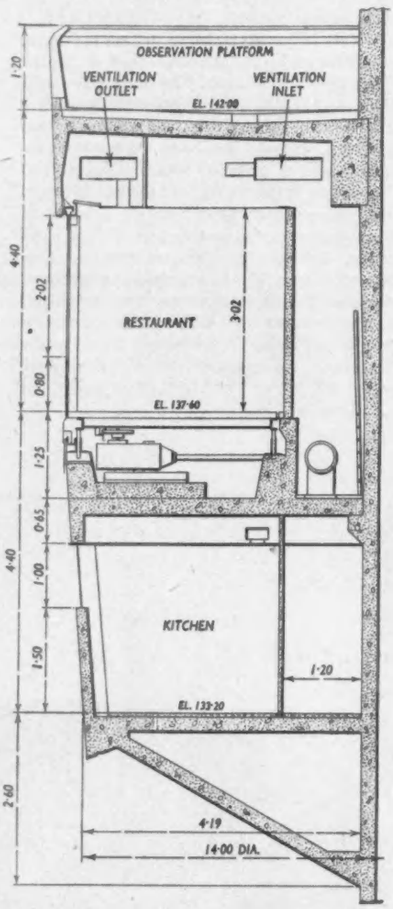
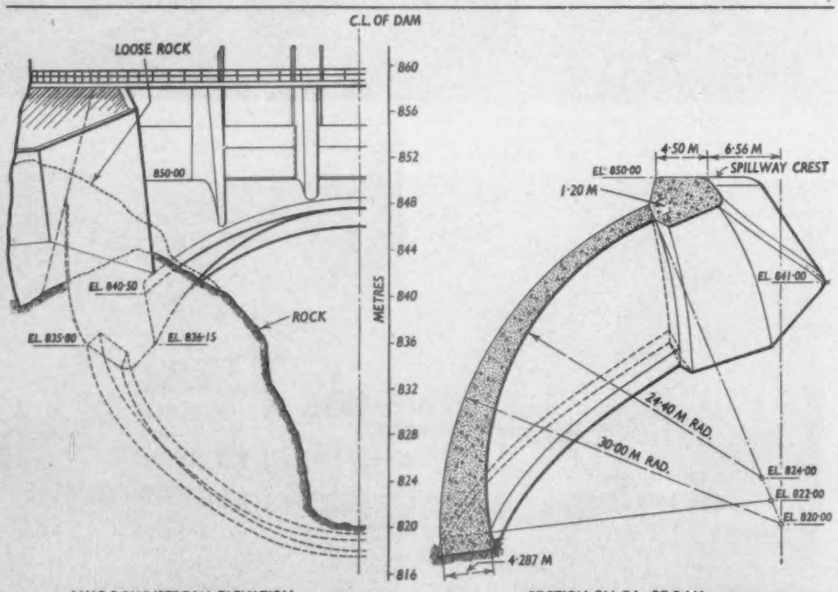


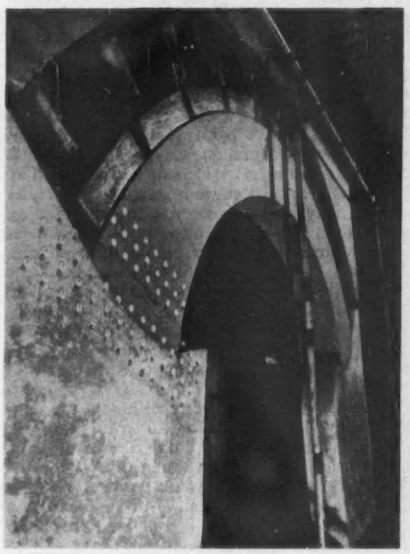
Fig. 2—Part section showing lower balcony containing the restaurant and kitchen, and surmounted by an observation platform. The restaurant floor and windows form a separate steel structure which can be rotated at between 2 and 6 revolutions per hour

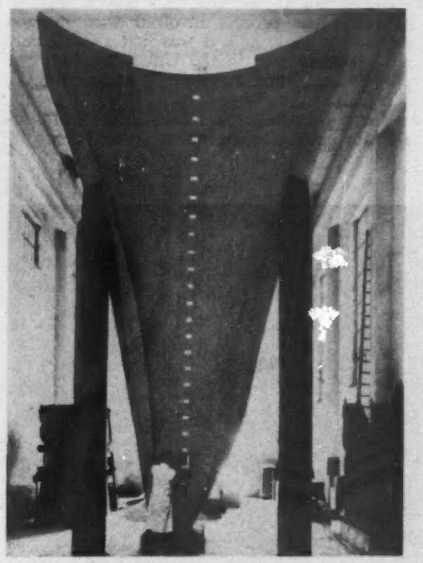


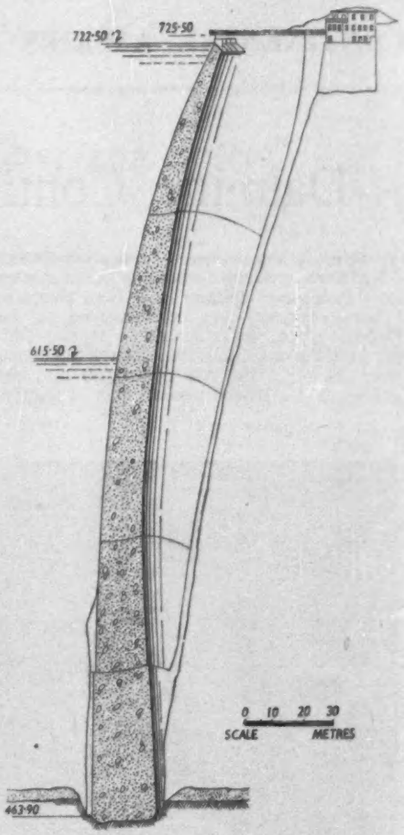
Sectional elevation and end view of Vodo dam (see also Plate 7). This dam is under construction on the Boite River as part of the Pinve-Boite-Mae-Valont hydro-electric scheme. The strongly curved cupola is supported on a saddle foundation and rests against the arch carrying the spillways; it is separated from these supports by joints. A fairly substantial amount of rock was excavated in order to obtain a symmetrical dam design

Italian Dams

The construction of the 261·6m high Valont Dam (see also Plate 7) was preceded by very careful research. Analysis of this slim cupola structure (RIGHT) was based on regulations dating from 1931 which require the dam to be regarded as a series of independent horizontal arches subjected to hydro-static pressure, thermal action, and shrinkage. One such element is shown under test at the ISMES laboratory at Bergamo (BELOW, LEFT). Theoretical and test results were compared with the behaviour of two 1 : 35 models of which the first is shown from the downstream side (BELOW, CENTRE). Levels are marked at 10m intervals on the reference axis, the line of symmetry sloping to the left at about 3 deg. The four horizontal joints, and two vertical joints between the dam and the saddles on either side, are shown as well as the vertical construction joints which will be grouted later.







With the reservoir empty, the first model showed horizontal elements to be in compression everywhere except for small tensions at some points of the abutments mostly at the 590m level. Vertical elements showed compression everywhere except at the plug base, as the arch effect makes dead weight flow sideways rather than down; and slight tensions also appeared at the crown area around the 700m level. These facts enabled the shape to be improved by taking a lunette of concrete off the downstream face, thereby increasing the curvature, and removing a triangle from the upstream face of each abutment. The dam faces are reinforced.

Construction is also well advanced at the Vodo Dam on the river Boite, here seen from the right bank (BELOW). A section of this very strongly curved dam will be found opposite. The broad arch to the right of the cupola is to carry the spillway.

CONTINENTAL AFFAIRS *(Continued)*

Dalmine Continuous Tube Mill

A MILL for the continuous production of tubes of 53mm to 92mm diameter (as well as another for "Pellegrino" (pilger) tubes from 60mm to 175mm diameter) was commissioned at the Dalmine S.p.A. works at Costa Volpino. Output from the new installation when in full operation will be at the rate of 150,000 tons per annum, and a second similar plant at another Dalmine works will go into service shortly. Although the process involved was invented some forty years ago, it was first applied only after the last war, in the United States. The present installation was built by Innocenti S.G., of Milan.

The plant comprises a cold billet shear suitable for cutting square billets up to 150mm by 150mm and R=55 kg per square millimetre. These are heated to 1300 deg. Cent. in a 40 tons per hour furnace, and then have their diagonals sized in a pair of sizing rolls, following which they are converted into bottles in two 250-ton vertical hydraulic piercing presses. Each press can produce three bottles per minute with a maximum diameter of 190mm and 1140mm long. A walking beam furnace reheats the bottles to 1200–1300 deg. Cent; they are then elongated in a cross rolling mill which also equalises wall thicknesses. In this mill, the 550mm diameter rolls of which are inclined at 6 deg. and driven by a 1000kW d.c. motor, four bottles per minute are produced with a maximum diameter of 153mm and a length of 1900mm. This procedure is stated to give better concentricity and utilises a cheaper grade of steel, than if—as is also possible—circular blooms are cut, and pierced on oblique rolls. Mandrels are inserted into the tubes as these emerge from the elongating mill. The continuous mill which follows comprises a roughing group, introducing stand, finishing group (Fig. 1) and sizing group. In the sizing group two vertical pairs and one horizontal pair of 300mm diameter rolls driven by a common 100kW d.c. motor size the tubes and at the same time release the mandrel all over the tube length. Mandrels range from 60mm to 90mm in diameter and their maximum length is 13m. After reheating, the tubes are passed through a stretch-reducing mill (Fig. 2), flying saw, and on to the cooling bed. The plant is driven by nine main d.c. motors, totalling 3715kW.

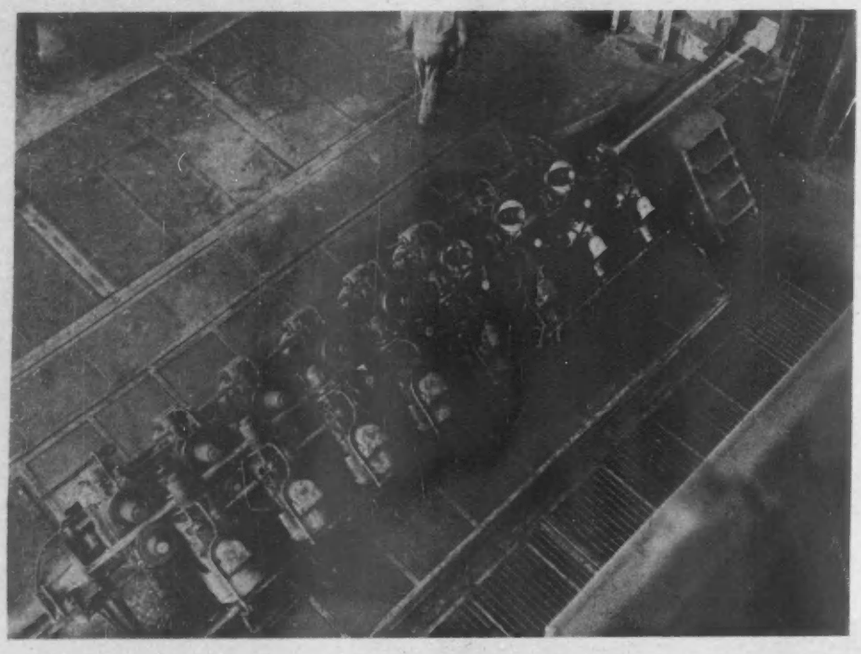


Fig. 1—Finishing stand of continuous tube mill, comprising two vertical and three horizontal stands powered each by a 500kW d.c. motor. The stands have rolls of 300mm diameter, but instead of fabric bearings as in the roughing group, are equipped with roller bearings

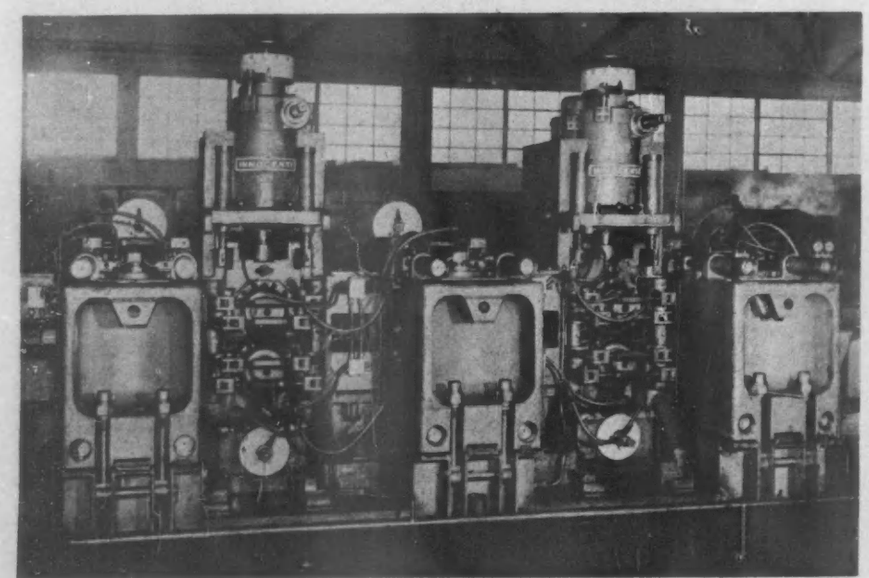


Fig. 2—Stretch-reducing tube mill with twenty-two roll stands having a roll diameter of 270mm. Maximum ingoing diameter is 100mm, minimum outgoing diameter 21mm. For these sizes the respective entry and delivery speeds are 1·5m and 6m per second. Tubes for this mill are preheated to 500-950 deg. Cent. in a 240 tube per hour melting beam furnace

Rivet Shearing Machine

Our illustration shows a rivet shearing machine for bench mounting which has been put on the market by Mager and Wedemayer, Bremen, Postfach 31. The device is intended for cropping to length rivets of light alloy, copper or brass from 2mm to 8mm diameter and steel rivets up to 5mm diameter. The desired length of shank can easily be obtained over the range 6mm to 20mm, by swivelling into position the requisite number of 1mm thick shim plates of which there are fifteen. The rivet is then inserted into the correct diameter hole and the end sheared off. It is stated that the cutting operation does not leave any burr or indentation on the shank.

Bench-mounted rivet shears with adjustable stops

THE AMERICAN SCENE

by Our American Editor

Continuous Casting of Wide Aluminium Sheet

A SEEMINGLY endless ribbon of ¼in thick, 3ft wide aluminium sheet flows steadily from a casting machine, passes through a roller straightener and an edge miller, and is wound into a tight, uniform coil. When the coil reaches a predetermined size and weight, a shear slices through the still moving ribbon of aluminium, the coil is quickly removed by a forklift truck, and the spooling of another coil of sheet is begun immediately. The entire operation takes place in less than 300 square feet of floor space, is tended by only one operator, and produces aluminium sheet at a rate of 30 to 40 linear inches per minute. Close examination of the cast sheet reveals a uniformly bright matt surface on both sides, clean-cut edges and a uniform thickness, both laterally and longitudinally. It looks very much like a coil of aluminium re-roll sheet produced by a conventional hot rolling installation. In fact, it serves the same purpose as normal hot-rolled sheet. The important difference is that this material was produced directly from molten metal without the use of costly slab casting stations, soaking pits, heavy breakdown mills, and hot rolling mills. It is the product of what probably is the first commercially successful continuous wide sheet casting process.

This process is now in everyday operation at the Riverside Works of the Hunter Engineering Company in California. Four units are producing sheet at this new plant, and two similar machines have been delivered to other aluminium fabricators, one in Los Angeles and one in Davenport, Iowa.

Stated in the simplest terms, the Hunter process is an ingenious short cut to sheet, substituting a single casting phase for all of the casting, scalping, heating, breakdown and rolling operations normally required to produce aluminium re-roll sheet. The installation consists of a combination melting and holding furnace, a continuous casting machine, a roller leveller, a shear, an edge miller and a coiler. Aluminium ingot is fed into the 15,000 lb capacity melting hearth of the reverberatory furnace, and molten metal flows through a channel into the 15,000 lb capacity holding hearth.

The double-hearth furnace is used so that the metal fed to the casting machine will remain at a uniform temperature—an extremely important factor. Any temperature variation resulting from the charging of cold ingots is confined within the melting hearth. From the holding hearth, molten metal flows from a tap-out box horizontally through a launder, then up through a spreader which distributes it uniformly across the width of the casting machine rolls. The molten bath in the tap-out box is held at a constant level slightly above the centre line of the rolls. Since molten metal, like water, seeks its own level, the metal is constantly under hydrostatic pressure as it enters the freezing zone slightly below the " bite " of the rolls.

These rolls are the heart of the process. They serve not only as a mould, but also as a heat sink and a source of motive power. A series of water passages is machined into the rolls. As water runs through these passages, it carries off the heat of fusion, causing the metal to change from the liquid to the solid state. The transformation takes place rapidly just below the centre line, and the rolls grip the now solid metal and push it upward. The rotation of the rolls is precisely synchronised with the rate of solidification. If they turn too fast the cycle is broken, if they run slow there is too much build-up at the interface of the spreader and the rolls. Another important variable is the temperature of the metal. This depends partly upon the alloy being cast, but the preferred practice is to hold the metal at as low a temperature as possible without freezing off the cycle. This keeps grain size as small as possible, and speeds solidification.

The 40in machine at Hunter Engineering produces 38in wide sheet at rates of 30in to 40in per minute. As the sheet emerges from the machine (Fig. 1) it loops down into a leveller, passes through an edge miller and is wound into a coil by the coiler. When the coil reaches a predetermined weight—usually between 3000 lb and 8000 lb, depending upon the customer's order—the operator shears the sheet, the coil is removed by forklift and the spooling of another coil is begun. The entire unit is almost completely automatic. The operator's principal job is to watch the temperature and level of the metal. If the temperature runs too high or too low he makes the necessary adjustments. If the metal level begins to drop he instructs the furnaceman to charge some more ingot.

Sheet is being cast in U.S. alloys 1100, 3003, 5005, 5050, 5052 and 6061. Others have been

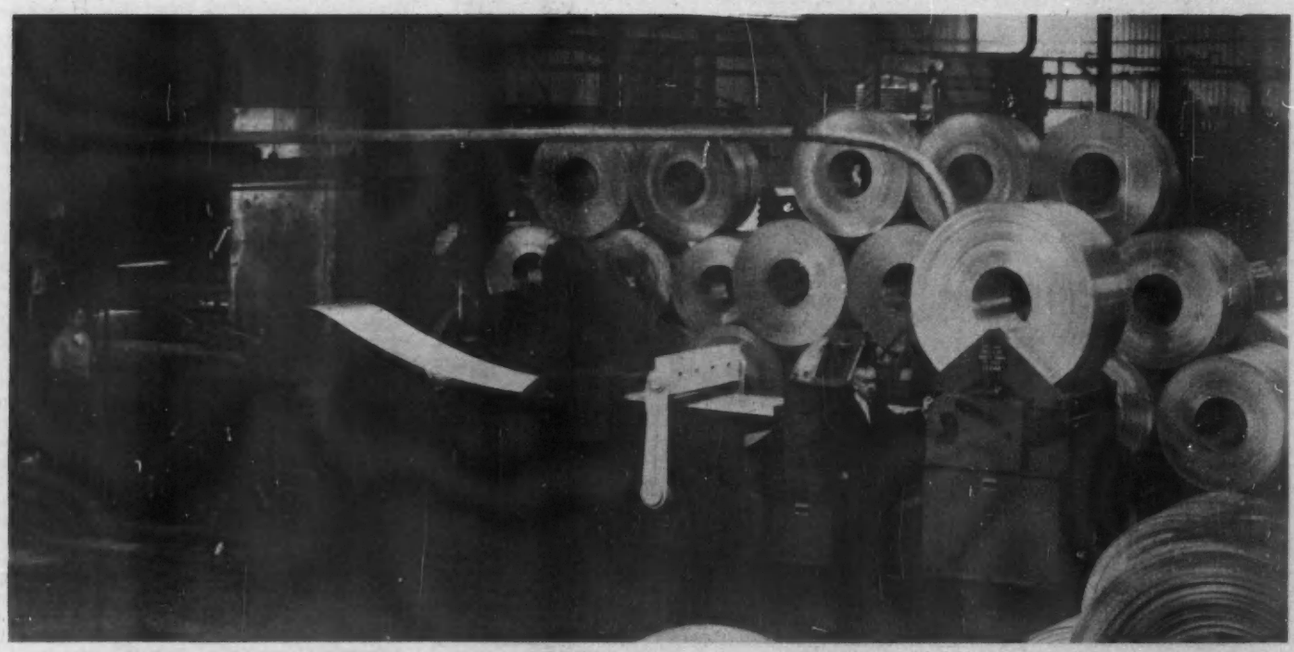


Fig. 1—40in wide continuous aluminium sheet casting installation, with combination furnace, casting machine, roller leveller, shear, edge miller and coiler

THE AMERICAN SCENE *(Continued)*

cast, but these alloys account for the bulk of the Hunter production. The structure of the sheet is very dense and solid and fairly fine-grained for a cast material. In a recent twenty-four hour period two machines turned out 90,000 lb of sheet. The weight of coils averages 5000 lb each. Theoretically, however, it would be possible to produce a coil of any weight.

Fig. 2—Large coil of continuously cast aluminium

The only real limitation is the capacity of the handling equipment (Fig. 2).

Most of the material cast on the 40in machine is subsequently re-rolled to finished sheet in gauges down to 0·003in. Although some alloys, particularly 3003, are homogenised before re-rolling, all rolling is accomplished cold, directly from cast materials. The mills used at Riverside are a two-stand four-high tandem mill and a single-stand four-high finishing mill. They were designed and built by Hunter Engineering and are illustrated in Figs. 3 and 4. Breakdown is accomplished on the tandem mill in one or two passes, depending upon the ultimate end use of the sheet. Finish gauge from the first pass may vary from 0·115in to 0·080in, while finish gauge from the second pass may be varied from 0·060in to 0·030in. The mill can roll sheet at rates of from 200,000 lb to 500,000 lb per eight-hour shift, depending upon the number of passes and the final gauge.

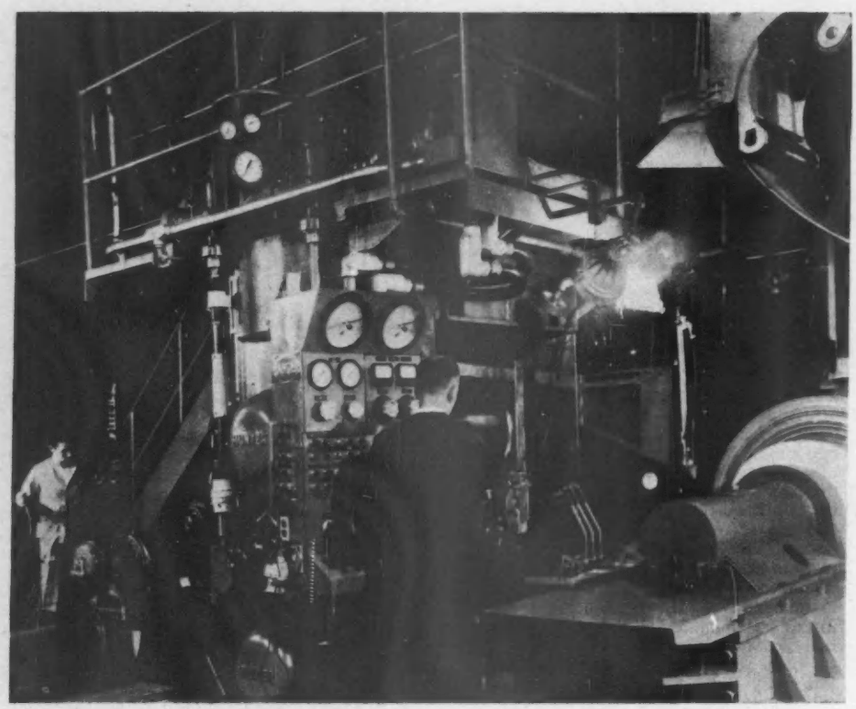


Fig. 4—Single-stand sheet finish rolling mill for the production of aluminium sheet down to 0·003in thickness

Finish temper passes and thinner gauges are rolled on the finishing mill, which can roll stock down to 0·003in. An outstanding feature of both mills is the exceptionally close control of gauge. Total gauge variation on the break-down passes can be held to ±0·0005in. On the finishing mill, gauge variation can be controlled within ±0·0002in. The rolling mills embody a number of innovations that permit this close control of gauge and also simplify operation. Instead of using the conventional screws to adjust roll positions, the entire mill is hydraulically preloaded through the bearing chocks. Since this preloading is in excess of the rolling pressures to be encountered, there are no deflections in the roll stand due to pressures developed in the rolling operations. In addition to improving the rolled product, this feature permits the operator to stop the rolling operation immediately in case of trouble. He simply releases the hydraulic preload pressure, thereby disengaging the work rolls.

Gauge control is accomplished by power-actuated gauge blocks situated between the bearing chocks. Due to the design of these blocks, the gauge of the rolled product may be adjusted instantly, in increments of 0·0001in, while the mill is operating under full load. Unlike conventional designs, the Hunter machines use mill housings assembled from precision ground forged steel columns which permit the fitting of bearing chocks and other working parts to closer tolerances than are possible with conventional cast steel housings.

Hunter designed both mills specifically for rolling aluminium. They can handle coils up to 60in in diameter and with a gross finish weight of 8500 lb. The mills have been "automated" to a high degree, and a three-man crew runs each mill. Thus, a work force of six men can produce up to 250 tons of aluminium sheet per eight-hour shift. The company is at present producing foil re-roll stock, coiled strip and sheet for a wide variety of customers. Its quality is suitable for roll-formed products, and it is also yielding a high grade of foil. The main reason for this appears to be the fast chill in the continuous casting machine, giving better dispersion of alloying constituents than one normally gets in re-roll stock. The constituents have less time to migrate to the grain boundaries, resulting in a favourable pinhole count on foil stock. This also cuts scrap loss to a very low level and improves the economics of the operation. Hunter concedes that there is room for improvement in the grain size of the as-cast re-roll stock. The finest-grain material is not as good as the finest grain one can get with conventional methods. For this reason, the firm does not recommend the sheet for applications that require deep drawing.

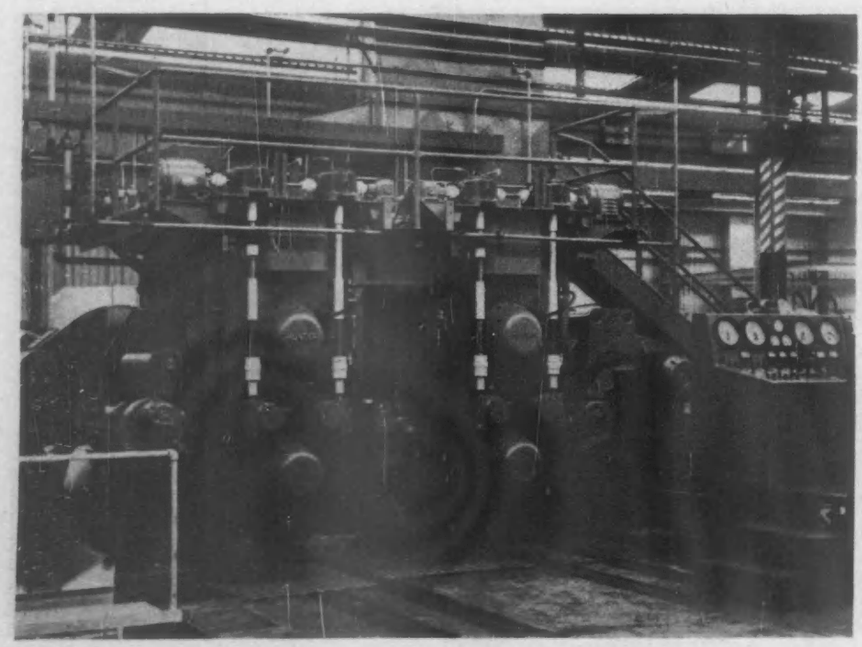


Fig. 3—Two-stand tandem sheet rolling mill at the Riverside works

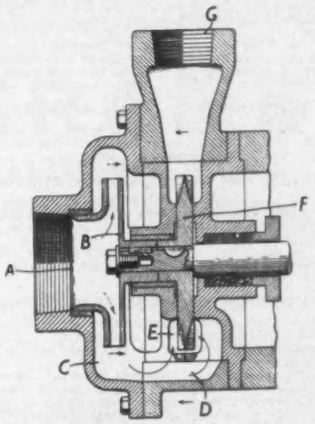
BRITISH PATENT SPECIFICATIONS

The dates printed are those of application and publication on completion. Copies of specifications may be obtained at the Patent Office Sales Branch, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

PUMPS

822,468. March 2, 1956.—COMBINATION CENTRIFUGAL AND CIRCUMFERENTIAL-FLOW PUMPS, Roy E. Roth Company, 2420, Fourth Avenue, Rock Island, Illinois, United States of America.

This invention relates to a form of combined centrifugal and circumferential-flow pump for liquids such as propane or anhydrous ammonia at or near the boiling point. In the operation of the design of pump described in detail in the specification, the liquid enters the suction entrance *A* of the centrifugal impeller *B* and is discharged from the periphery of this impeller into the volute channel *C* at increased pressure and higher velocity. Under the pressure of the centrifugal force of the first stage the liquid passes through the suction entrance *D* into the annular liquid channel *E* of the turbine stage. The regenerative pumping action of the turbine impeller *F* builds up sufficient pressure to deliver the liquid to the outlet *G* of the turbine stage, by constant recirculation of the liquid through the impeller vanes



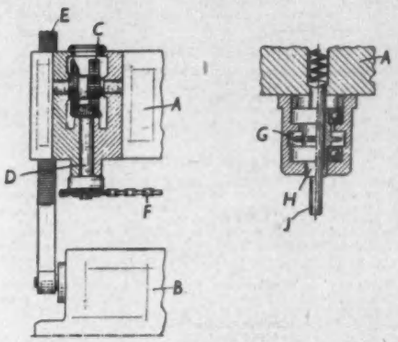
No. 822,468

and annular channel *E* for nearly a full revolution of the impeller. Since the liquid in the suction entrance of the turbine second stage is always under the pressure from the centrifugal first stage, vaporisation cannot occur, and this stage will not "vapour bind." Further, it has been found that the centrifugal type pump, when properly designed for handling liquids at or near the boiling point, and operating with a static suction head, will itself not "vapour bind" except at terminal or shut-off pressure, because, since there is no recirculation of the liquid and because of the smooth exterior of the impeller, very little heat is added to the pumped liquid.—*October* 28, 1959.

MACHINE TOOLS

824,067. September 16, 1957.—CUTTING SCREW-THREADS IN A PRESS, Fabrique John A. Chappuis S.A., Peseux, Switzerland.

In the example of the invention described a die set comprises a punch-holder or top element *A* and a die or bottom element *B* operated by a press (not shown) which raises and lowers the punch-holder along the columns. The punch-holder can be fitted with tools co-operating with the die in addition to thread-cutting tools, or it can be equipped merely for thread-cutting. Near one edge the punch-holder has a gearbox containing a wheel *C* meshing through bevel gears with a spindle *D* which has a chain wheel at the bottom. The wheel *C* is secured to a pinion meshing with a toothed rack *E*, the lower end of which is secured to the die set. When the two elements are moved towards one another by the press, the pinion moves down the rack and rotates the whole of the gear train including the chain wheel. A chain *F* driven by the wheel passes around and drives other chain wheels such as *G* on a rotatable member *H*. This member, *H*, is housed in a sleeve secured below the head element and containing two ball bearings in which *H* rotates. A spindle *J* in the tubular member has two flats along its side by which it is rotated by *H*, but left to slide axially. The spindle has a head by which it is retained in a corresponding aperture in the element *A* against the action of a spring. The free lower end of the spindle carries the tap or die. When the punch-holder is lowered towards the die the tap or die will also be lowered, with rotation, towards the workpiece. The gear train provides a step-up transmission ratio in order that a die or tap may be rotated rapidly enough to perform at least the number of revolutions associated with the travel and the thread to be cut. Since the punch-holder and the die can also be used for other operations involving cutting and shaping of the workpiece, it would of course be excessively complicated if the spindle always had to be advanced in dependence upon its speed of rotation and upon the screw thread to be cut. This is why the spindle *J* is free to move axially against the spring, and need not necessarily follow the movement of the element which bears it. A number of spindles can be provided in a die set to rotate at different speeds should the threads to be cut simultaneously have different pitches.—*November* 25, 1959.

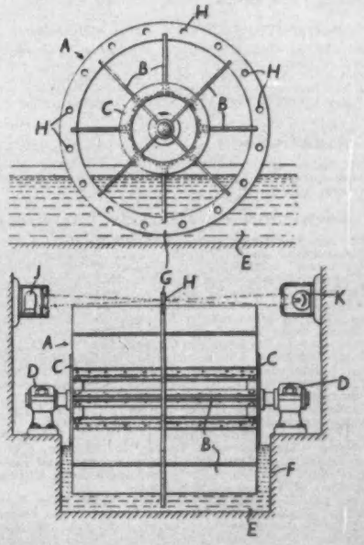


No. 824,067

ELECTRONICS

824,082. April 24, 1956.—FLUID FLOWMETERS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2. (*Inventor: Frank Glave Ainsworth.*)

This invention relates to fluid flowmeters and is particularly but not exclusively concerned with a flowmeter which can provide an indication of the rate of flow of a liquid in circumstances where the power available from the liquid flow is small and mechanical loading has therefore to be kept small for the meter to operate properly. One embodiment is illustrated in the accompanying schematic drawings. Referring to the upper drawing, a paddle wheel *A*, comprising a number of paddles *B* supported between annular plates *C* forming part of the hub of the wheel, is mounted in bearings *D* (lower drawing) so as to be capable of rotation by liquid *E* flowing along a channel *F*. The paddles have secured fast to their radially outer ends an annular disc *G* which is formed with equally spaced circumferentially distributed apertures. As the wheel rotates, and with it the disc *G*, the apertures come one after another into alignment between a light source *J*, which provides a beam of light shining across the channel, and a photo-electric cell *K* which is illuminated by the light beam as each aperture comes into alignment. Consequently as the wheel rotates under the action of liquid flow in the channel, the photocell will receive the light beam intermittently and will produce a corresponding pulse signal in which the repetition frequency of the pulses will be proportional to the rate at which the liquid in the channel is flowing.—*November* 25, 1959.

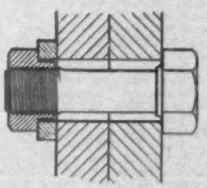


No. 824,082

NUTS AND BOLTS

824,012. February 3, 1958.—NUT AND BOLT CONNECTIONS, Gilbert Roberts, 68, Victoria Street, London, S.W.1, and A. P. Newall and Co., Ltd., Woodside Engineering Works, Possilpark, Glasgow, N.

When tightening high tensile bolts a usual procedure consists of screwing up the nut to a predetermined torque which is calculated to produce a tension stress in the bolts not exceeding 80 or 90 per cent of the yield stress. The estimation of the torque involves an assumption of the coefficients of friction on the threads and between the nut and the washer, which are subject to considerable variation. This uncertainty of the frictional resistance and errors in the torque measurement may lead to large discrepancies in the tension actually applied to the bolt, with the result that a proportion of the bolts so tightened either break or become loose in service. The invention provides the nut and bolt connector for joining together two structural members shown in the drawing. The high tensile steel bolt is waisted, its shank being of considerably less diameter than the holes in the two plates which are joined together. The cross sectional area of the shank of the bolt does not exceed the effective cross sectional area of its threaded portion, so that when overstrained the bolt will break in the shank, instead of in the threads, with the "waisting" usually associated with a round tensile test piece. Such a bolt is capable of a large plastic extension before it breaks and it can be tensioned to the full ultimate stress of the material with an adequate margin of extension still in hand. The nut is reduced for part of its length to provide a cylindrical portion of less outside diameter than the width over the flats. This cylindrical portion is seated with clearance in a thick washer of high tensile steel. In installation, the nut is rotated to a point at which the tensile stress in the bolt is equal to or slightly less than its ultimate stress. If a standard nut were used, excessive concentration of load would occur when the nut is tightened to stress the bolt on the first threads, i.e. those nearer the plates to be joined. As, however, the load is applied to the nut through the washer at a point some distance from its inner end, the nut can be rotated to impose tension on the bolt without excessive concentration of load on the first threads, the cylindrical portion of the nut deforming slightly within the clearance permitted by the washer and so preventing seizure on the thread.—*November* 25, 1959.



No. 824,012

Catalogues and Brochures

RANSOMES AND RAPIER, Ltd., Waterside Works, Ipswich.—Publication No. 1/528 dealing with concrete mixers and water pumps.

KODAK, Ltd., Finisher Sales Division, Kodak House, Kingsway, London, W.C.2.—Illustrated folder describing "Velox" sodium safelamp and Kodak Bromide sodium safelamp.

VERNONS INDUSTRIES, Ltd., Kirkby Industrial Estate, Liverpool.—Leaflet describing the transistorised automatic voltage regulators and voltage and frequency limiting relays developed for use with the company's generating sets.

BELL'S ASBESTOS AND ENGINEERING, Ltd., Bestobell Works, Slough, Bucks.—Illustrated brochure containing technical details of "Viceroy" pre-formed thermal insulation, designed for use where hot face temperatures do not exceed 650 deg. Fah.

A.E.I. LAMP AND LIGHTING COMPANY, Ltd., 44, Fitzroy Road, London, N.W.1.—Leaflet entitled "Lighting for Industrial Roads," illustrating "Mazda" lamps and street-lighting columns for industrial use, and explaining basic rules and factors which affect planning.

BX PLASTICS, Ltd., Higham Station Avenue, Chingford, London, E.4.—Brochure illustrating some of the plastics materials available for packaging, and various applications of these materials. The brochure deals with polythene, transparent films, rigid sheet and moulding powders.

MIDLAND SILICONES, Ltd., 68, Knightsbridge, S.W.1.—A new "controlled circulation" newsletter entitled "Midland Silicone News," featuring information about the ways in which silicones are used to-day in many industries. Initially the publication will appear bi-monthly.

THE ENGLISH ELECTRIC COMPANY, Ltd., Stafford.—New publications entitled "Steam Turbines," (ST/122); "Marine Steam Turbines" (MR/111); "Gas Turbines" (GT/103); "Diesel Engines" (DE/217); "Induction Motors" (PS/133); and "High Slip, High Torque Motors" (DM/257).

STANDARD TELEPHONES AND CABLES, Ltd., Connaught House, 63, Aldwych, London, W.C.2.—Illustrated brochure describing the "Stantec-Zebra" medium-sized electronic digital computer. Intended in the first instance for mathematical use, the computer is stated to be sufficiently flexible to operate with a variety of peripheral equipment, and in this way may be used as the control centre for small data processing systems.

STURTEVANT ENGINEERING COMPANY, Ltd., Southern House, Cannon Street, London, E.C.4.—Publication No. 9606, entitled "Laboratory Machinery," dealing with crushing and grinding equipment, screening and separating plant, and mixing and sampling equipment. Publication No. 2504, describing multi-vane fans type "MVAZ," for use in heating and ventilation; air conditioning plants, drying, fume exhaust and boiler draught applications. Capacity tables are included in this publication.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ANTIQUARIAN HOROLOGICAL SOCIETY

Fri., Jan. 8.—Science Museum, Kensington, London, S.W.7, "Bells and Bellfounding," Douglas Hughes, 7 p.m.

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

Mon., Jan. 4.—BOLTON BRANCH: Railway Hotel, Trinity Street, Bolton, "Fire Protection by the Mulsifyre System," R. J. Mowle, 7.45 p.m. ★ LEEDS BRANCH: Great Northern Hotel, Leeds, "Radio Control," E. B. Hill, 7.30 p.m. ★ SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield, "Earth Impedance and Earth Leakage Testing," P. Laughton, 7.30 p.m.

Tues., Jan. 5.—READING AND DISTRICTS BRANCH: "Marquis of Lorne," Friar Street, Reading, "Floor Screens, with particular reference to Floor Warming," H. C. Young, 7.30 p.m. ★ WEST LONDON BRANCH: Windsor Castle Hotel, 134, King Street, Hammersmith, W.6, "Motor Control Gear," R. F. Mathieson, 7.30 p.m.

Wed., Jan. 6.—HALIFAX BRANCH: Crown Hotel, Horton Street, Halifax, "Floor Heating," 7.45 p.m. ★ MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, 2, Branch Lecturettes and the Association and its Committees, 7.15 p.m. ★ NORTH LONDON BRANCH: Wood Green Civic Centre, Town Hall, Wood Green, N.22, Colour Film of the 1959 Electrical Engineers (A.S.E.E.) Exhibition and "New Light on Niagara," 8 p.m. ★ PRESTON BRANCH: R.A.F.A. Club, East View, Preston, "H.M. Factories Acts in Relation to Electrical Installation," D. A. Picken, 7.30 p.m.

Fri., Jan. 8.—LIVERPOOL AND DISTRICT BRANCH: Industrial Development Centre, M.A.N.W.E.B., Paradise Street, Liverpool, 1, "Control Centres for Modern Industry," R. Ritchie, 7.30 p.m.

BRITISH COMPUTER SOCIETY

Mon., Jan. 4.—MIDDLESBROUGH BRANCH: Constantine Technical College, Borough Road, Middlesbrough, "Experience with a Computer," N. C. Pollock, 7.30 p.m.

Tues., Jan. 5.—NEWCASTLE BRANCH: University Computing Laboratory, 1, Kensington Terrace, Newcastle, "Commercial Experience with a Computer," N. C. Pollock, 7 p.m.

Wed., Jan. 13.—BIRMINGHAM BRANCH: Large Theatre, Electrical Engineering Department, The University, Edgbaston, Birmingham, Symposium on "The Use of Computers for the Solution of Logical Problems—(*a*) 'Examination Timetables,' and (*b*) 'Railway Timetables,'" 6.30 p.m. ★ HULL BRANCH: Chamber of Commerce, Samman House, Bowlalley Lane, Hull, "Sorting and Summarising Methods for Computers," C. M. Berners-Lee, 7.30 p.m.

Thurs., Jan. 14.—BELFAST BRANCH: 29, University Square, Belfast, "The Use of a Computer in Business Planning," C. M. Berners-Lee, 7.15 p.m.

BRITISH INSTITUTE OF MANAGEMENT

Wed., Jan. 6.—Recital Room, Royal Festival Hall, London, Half-day Conference on "Judging the Success of a Business—Using the Return on Capital Ratio," opened by F. Sewell Bray, 9.30 a.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Wed., Jan. 6.—RADAR GROUP: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, "Some New Possibilities in Civil Underwater Echo-ranging—Current Research at the University of Birmingham," D. G. Tucker, 6.30 p.m.

Mon., Jan. 11.—MERSEYSIDE SECTION: University Club, 2, Mount Pleasant, Liverpool, "High Frequency Propagation—its Present and Future Use for Communication Purposes," A. F. Wilkins, 7 p.m.

Wed., Jan. 13.—LONDON SECTION: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, "A Proposed Space-charge-limited Dielectric Triode," G. T. Wright, 6.30 p.m. ★ SOUTH WALES SECTION: Welsh College of Advanced Technology, Cardiff, "Television Broadcasting Methods," H. J. M. Hockley and N. Hughes, 6.30 p.m. ★ NORTH EASTERN SECTION: Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle upon Tyne, "Data Processing Machines," J. Allen and J. Keating, 6 p.m. ★ WEST MIDLANDS SECTION: Wolverhampton and Staffordshire College of Technology, Wulfruna Street, Wolverhampton, "Electronics in Medicine," P. Styles, 7.15 p.m.

BRITISH INTERPLANETARY SOCIETY

Sat., Jan. 9.—Lecture Theatre, Science Museum, London, S.W.7, Film Show on "Astronautics," 7 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Wed., Jan. 13.—NORTHERN REGION: Royal Station Hotel, Paragon Square, Hull, "The Workings of the Clean Air Act," 2.30 p.m.

ILLUMINATING ENGINEERING SOCIETY

Wed., Jan. 6.—SWANSEA GROUP: Demonstration Theatre, South Wales Electricity Board, The Kingsway, Swansea, Chairman's Address, J. R. Smith, 6.30 p.m.

Mon., Jan. 11.—SHEFFIELD CENTRE: Grand Hotel, Sheffield, Presidential Address, H. G. Campbell, 6.30 p.m.

Tues., Jan. 12.—GLASGOW CENTRE: Kenilworth Hotel, Queen Street, Glasgow, "Modern Lighting Techniques," M. J. Powley, 8 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., Jan. 13.—SOUTHAMPTON SECTION: Technical College, St. Mary's Street, Southampton, Film, "The Foundryman's Raw Materials," 7.30 p.m.

Thurs., Jan. 14.—BEDS AND HERTS SECTION: Town Hall, Luton, "Properties of Copper-Base Alloy Castings," F. Hudson, 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Mon., Jan. 4.—MERSEYSIDE AND NORTH WESTERN SECTION: Liverpool Engineering Society, The Temple, Dale Street, Liverpool, "Fundamentals of Steam Turbine Thermodynamics," W. L. Coventry, 6 p.m.

Mon., Jan. 11.—MERSEYSIDE AND NORTH WESTERN SECTION: Stephenson Room, Engineers' Club, Albert Square, Manchester, 2, "Human Problems in Marine Engineering," C. C. Pounder, 6.45 p.m.

Wed., Jan. 13.—MERSEYSIDE AND NORTH WESTERN SECTION: International Library, Central Libraries, William Brown Street, Liverpool, "The Docks and Sea Channels of the Port of Liverpool," R. H. Stevenson, 7.30 p.m.

INSTITUTE OF METAL FINISHING

Wed., Jan. 13.—British Institute of Management, 80, Fetter Lane, London, E.C.4, "Stoving Paint Systems," A. W. Greig and F. G. Randall, 6.30 p.m.

INSTITUTE OF REFRIGERATION

Thurs., Jan. 7.—Institute of Marine Engineers, Memorial Building, 76, Mark Lane, London, E.C.3, "Some Lubricating Problems of Refrigerating Machines using Refrigerant 12," H. Heckmatt, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Tues., Jan. 5.—WESTERN CENTRE: Royal Hotel, Bristol, "The Use of Plastics in Road Transport," J. Langford-Allen, 6.30 p.m.

Wed., Jan. 6.—EAST MIDLANDS CENTRE: Mechanics' Institute, Nottingham, "The Design and Construction of the 'Routemaster' Bus," A. G. Higgins, 7.30 p.m.

INSTITUTE OF WELDING

Tues., Jan. 5.—CHRISTMAS LECTURE TO YOUNG PEOPLE: 54, Princes Gate, London, S.W.7, "The Magic Arc," Hugh O'Neill, 11 a.m.

INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS

Mon., Jan. 4.—WEST MIDLANDS CENTRE: Room No. 118, Gosta Green Technical College, Birmingham, "The Forage Harvester and Work Study in Relation to Silage Making and Feeding," F. S. Mitchell and N. W. Dilke, 7.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS

Tues., Jan. 5.—Geological Society, Burlington House, London, W.1, "Heat Transfer to Two-Phase Gas/Liquid Systems—Part I," J. A. R. Bennett, J. G. Collier, H. R. C. Pratt and J. D. Thornton; and "Pressure Drop and Hold-Up in Two-Phase Flow," J. G. Collier, J. D. Thornton and J. A. R. Bennett, 5.30 p.m.

INSTITUTION OF CIVIL ENGINEERS

Wed., Jan. 6.—DUGALD CLERK LECTURE: Great George Street, Westminster, London, S.W.1, "Dredging Equipment," H. R. Cooper, 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Jan. 4.—MERSEY AND NORTH WALES CENTRE: Donnan Laboratories, Vine Street, Liverpool, "Silicone Electrical Insulation," J. H. Davis, 6.30 p.m. ★ SOUTH MIDLAND CENTRE: James Watt Memorial Institute, Birmingham, Discussion on "Post-Graduate Academic Training Given Within Industry," opened by R. F. Marshall, 6 p.m.

Tues., Jan. 5.—MEASUREMENT SUPPLY AND UTILIZATION SECTIONS: Savoy Place, London, W.C.2, "A New Method for Observing the Phenomena of Commutation," H. J. H. Sketch, P. A. Shaw and R. J. K. Splatt; and "A Method of Measuring Self-Inductances Applicable to Large Electrical Machines," J. C. Prescott and A. K. El-Kharashi, 5.30 p.m. ★ NORTH-WESTERN CENTRE: Engineers' Club 17, Albert Square, Manchester, Second Hunter Memorial Lecture, "The Protection of Electrical Systems," H. G. Bell, 6.15 p.m.

Wed., Jan. 6.—SOUTHERN CENTRE: C.E.G.B. Offices, Portsmouth, "Non-Destructive Testing," E. McCabe, 6.30 p.m. ★ TEES-SIDE SUB-CENTRE: Cleveland Scientific and Technical Institution, Middlesbrough, North-Eastern Centre Chairman's Address, H. Watson-Jones, 6.30 p.m.

Thurs., Jan. 7.—ORDINARY MEETING: Savoy Place, London, W.C.2, Second Hunter Memorial Lecture, "The Protection of Electrical Systems," H. G. Bell, 5.30 p.m. ★ WESTERN CENTRE: Technical College, Swindon, Joint meeting with the Western Branch of the Institution of Mechanical Engineers, "The 'Deltic' Locomotive," C. M. Cock, 6 p.m.

Fri., Jan. 8.—MEDICAL ELECTRONICS DISCUSSION GROUP: Savoy Place, London, W.C.2, Discussion on "Electrical and Electronic Techniques in Respiratory Research," opened by R. Woolmer and D. W. Hill, 6 p.m.

Mon., Jan. 11.—ELECTRONICS AND COMMUNICATIONS SECTION: Savoy Place, London, W.C.2, "A Quadrature Network for Generating Vestigial-Sideband Signals," G. G. Gouriet and G. F. Newell: "The Input Impedance of Rectifier Modulators," D. G. Tucker; and "Rectifier Modulators with Frequency-Selective Terminations, with particular reference to the Effect of Even-Order Modulation Products," D. P. Howson and D. G. Tucker, 5.30 p.m. ★ NORTH-EASTERN CENTRE: Neville Hall, Westgate Road, Newcastle upon Tyne, "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott, 6.15 p.m. ★ SOUTH MIDLAND SUPPLY AND UTILIZATION GROUP: College of Technology, Gosta Green, Birmingham, "Electrical Supplies to Power Station Auxiliaries," D. A. Dewison, 6 p.m. ★ WESTERN CENTRE: The University, Bristol, "The Application of Low-Pressure Resins to Some High-Voltage Switchgear Designs," T. R. Manley, K. Rothwell and W. Gray, 6 p.m.

INSTITUTION OF ENGINEERING DESIGNERS

Wed., Jan. 6.—MIDLANDS BRANCH: Queens Hotel, Birmingham, "Measuring and Gauging Equipment," T. Ellerby, 7 p.m.

INSTITUTION OF HIGHWAY ENGINEERS

Wed., Jan. 6.—EAST ANGLIAN BRANCH: Assembly House, Theatre Street, Norwich, Film Show and Engineering Quiz, 6.45 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

Mon., Jan. 4.—NORTH EASTERN BRANCH: Neville Hall, Newcastle upon Tyne, "Atomic Energy Factories: Design and Construction Problems," H. V. Disney, to be read by H. Norris, 6 p.m.

Wed., Jan. 6.—EAST MIDLANDS BRANCH: College of Further Education, Loughborough, Annual Meeting; and "Design by Analogy," J. O'N. Fisher, 7 p.m.

Thurs., Jan. 7.—EASTERN BRANCH: Argyle Works, Stevenage, Chairman's Address, "Mechanical Seals," R. G. Allen, 7.30 p.m. ★ EAST MIDLANDS GRADUATES' SECTION: Gas Showrooms, Peterborough, "Some Aspects of Machine Tool Design for the Future," F. A. Lewis, 7.15 p.m.

Sat., Jan. 9.—EASTERN GRADUATES' SECTION: Visit to Reavell and Co., Ltd., Ipswich, 9 a.m. ★ LONDON GRADUATES' SECTION: Visit to Arthur Guinness, Son and Co., Ltd., Park Royal, 10.30 a.m.

Tues., Jan. 12.—AUTOMOBILE DIVISION: 1, Birdcage Walk, London, S.W.1, Crompton-Lanchester Lecture, "Combustion Chamber Design and the Influence of Fuel Quality," D. Downs, 6 p.m.

Wed., Jan. 13.—LONDON ORDINARY MEETING: 1, Birdcage Walk, London, S.W.1, "The Strength of Rails with Particular Reference to Rail Joints," S. Wise, D. Lindsay and I. G. T. Duncan, 6 p.m.

INSTITUTION OF NAVAL ARCHITECTS

Thurs., Jan. 7.—10, Upper Belgrave Street, London, S.W.1, "The 'Brave' Class Gas-Turbine Fast Patrol Boats," J. T. Revans and A. A. C. Gentry, 4.45 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Mon., Jan. 11.—EAST AND WEST RIDINGS REGION: Hotel Metropole, King Street, Leeds, 1, "Production Engineering Problems in Connection with the Manufacture of Tubes," D. B. Such, 7 p.m.

Tues., Jan. 12.—EAST AND WEST RIDINGS REGION: Technical College, Doncaster, "Designing and Applying Carbide Tools," 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Tues., Jan. 5.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institution, Middlesbrough, "Structures in Areas of Mining Subsidence," D. W. Cooper and J. D. Geddes, 6.30 p.m.

Wed., Jan. 6.—NORTHERN COUNTIES BRANCH: Neville Hall, Newcastle, "Structures in Areas of Mining Subsidence," D. W. Cooper and J. D. Geddes, 6.30 p.m.

Fri., Jan. 8.—WESTERN COUNTIES BRANCH: University Engineering Laboratories, Bristol, "Practical Applications of the Engineer's Training," C. E. Saunders, 6 p.m.

Wed., Jan. 13.—YORKSHIRE BRANCH: Royal Victoria Hotel, Sheffield, "The Clifton Bridge, Nottingham," R. M. Finch and A. Goldstein, 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Jan. 1.—Pepys House, 14, Rochester Row, Westminster, London, S.W.1, Films, "Empire Links," and "Desert Bounty," 7 p.m.

Wed., Jan. 6.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Production Engineering in Textiles," G. A. Coglan, 7 p.m.

Fri., Jan. 8.—NORTH WESTERN SECTION: Engineers' Club, Albert Square, Manchester, "Human Relations in the Electricity Supply Industry," 7.30 p.m. ★ LONDON SECTION: Pepys House, 14, Rochester Row, London, S.W.1, "Coastal Shipping," H. Higgs, 7 p.m.

NEWCOMEN SOCIETY

Wed., Jan. 6.—Science Museum, London, S.W.7, "The Coalbrookdale Group Horsehay Works: Part 2," R. A. Mott, 5.30 p.m.

PLASTICS INSTITUTE

To-day, Jan. 1.—LECTURE FOR YOUNG PEOPLE: Institution of Electrical Engineers, Savoy Place, London, W.C.2, "Sticky Plastics," N. A. de Bruyne, 2.30 p.m.

Mon., Jan. 11.—MIDLANDS SECTION: Grand Hotel, Leicester, "Some Recent Developments in Plastics and Rubber Machinery," K. Wilson, 6.45 p.m.

REINFORCED CONCRETE ASSOCIATION

Wed., Jan. 6.—11, Upper Belgrave Street, London, S.W.1, "Vibration Control in Machine Foundations," J. H. A. Crockett, 6 p.m.

ROYAL INSTITUTION OF CHARTERED SURVEYORS

Mon., Jan. 4.—ORDINARY GENERAL MEETING: 12, Great George Street, Westminster, London, S.W.1, "The Effect of Industrial Development in Rural Areas," Colin Clark, 5.45 p.m.

ROYAL METEOROLOGICAL SOCIETY

Wed., Jan. 6.—49, Cromwell Road, London, S.W.7, "Mountain Waves," C. E. Wallington, 5.30 p.m.

SCIENCE MUSEUM—CHRISTMAS LECTURES FOR BOYS AND GIRLS

To-day, Jan. 1.—Science Museum, South Kensington, London, S.W.7, "Science and Magic," John Cain, 2.30 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Wed., Jan. 13.—CORROSION GROUP: 14, Belgrave Square, London, S.W.1, "Corrosion Problems of High Temperature Pressurised Water Reactors," J. N. Wanklyn, 6 p.m.

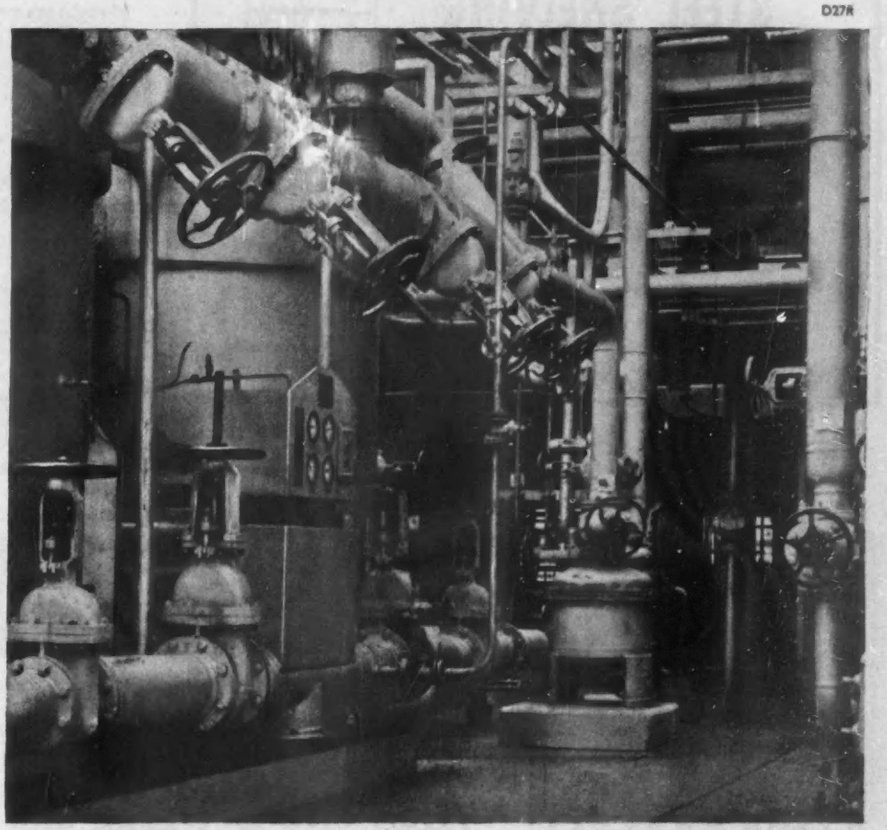
WOMEN'S ENGINEERING SOCIETY

Wed., Jan. 13.—LONDON BRANCH: Hope House, 45, Great Peter Street, Westminster, London, S.W.1, "Health Physics and Nuclear Power," B. C. Godbold, 7 p.m.

Once again, valves by Crane

D27R

With the recent completion of yet another Olefine Plant at the Wilton Works of Imperial Chemical Industries Limited, there are now three in operation. In all of them Crane valves are performing duties under arduous conditions (extremes of temperature). In the plant illustrated here Crane steel valves up to 16-inch are employed. Industry is looking more and more to Crane valves for performance and dependability. The Crane reputation is founded on modern production methods, individual testing at the factory and the high grade materials which go into every one of the Crane products. This Plant was designed and installed by Kellogg International Corporation.



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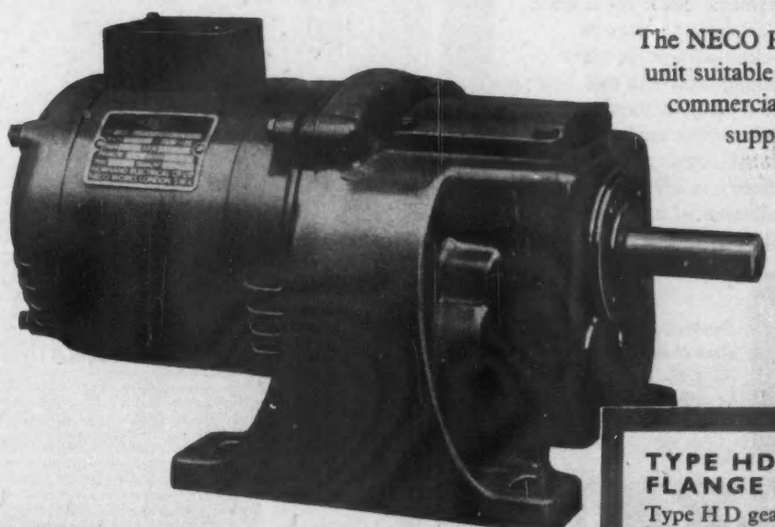
type H D geared motors



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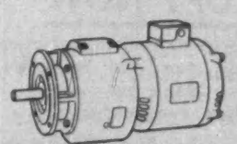

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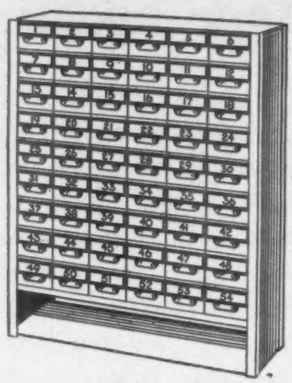

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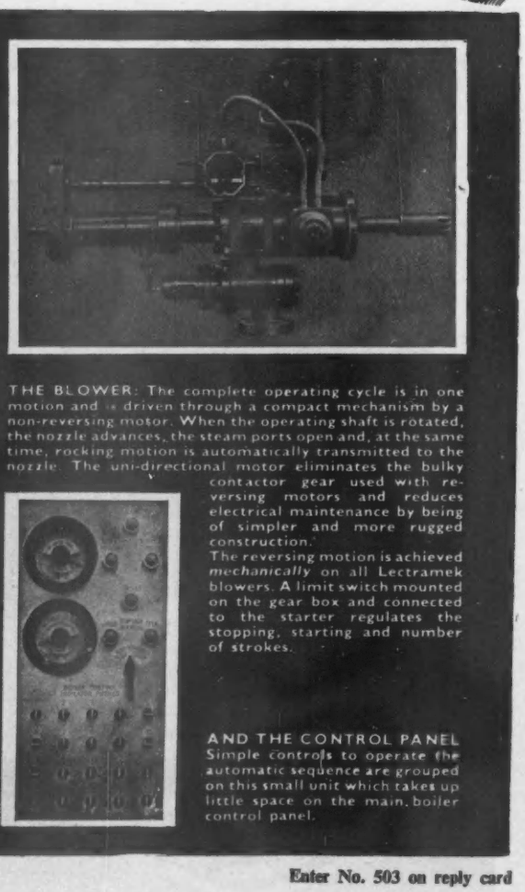

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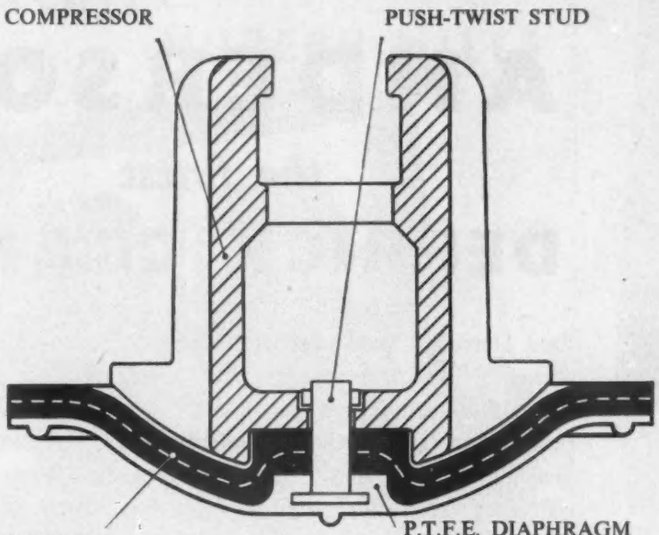

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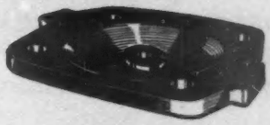

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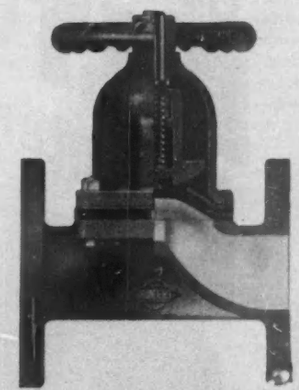

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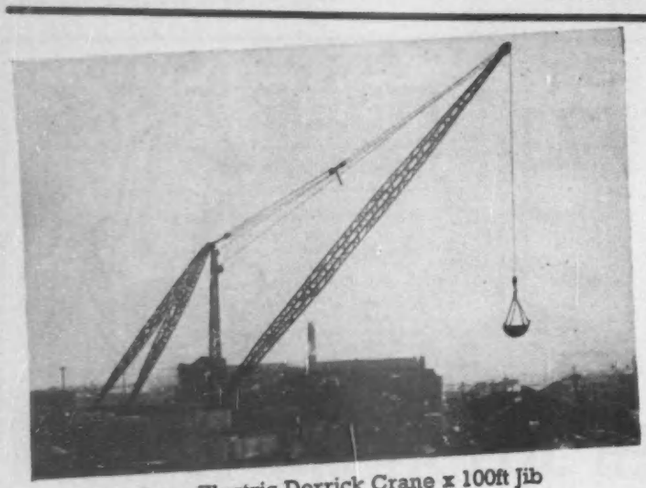

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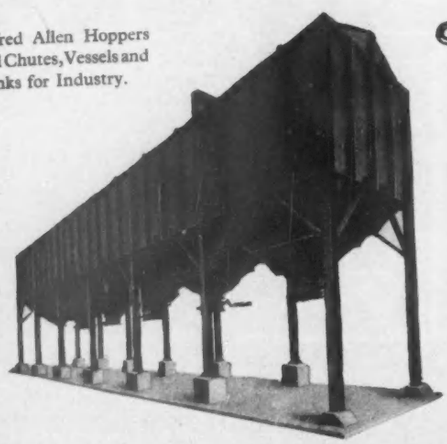

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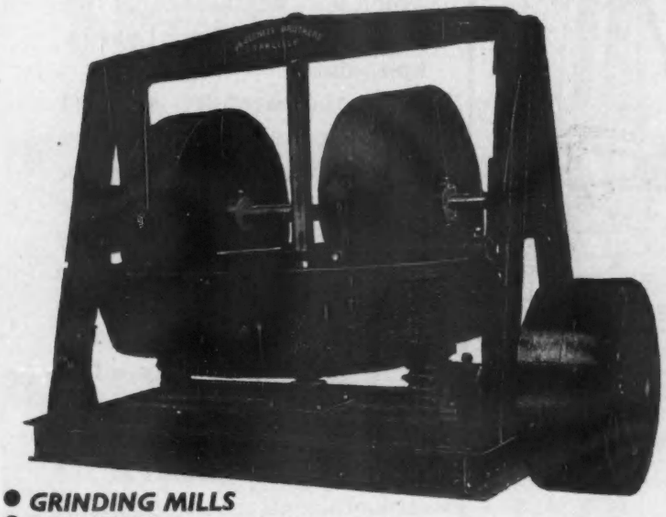

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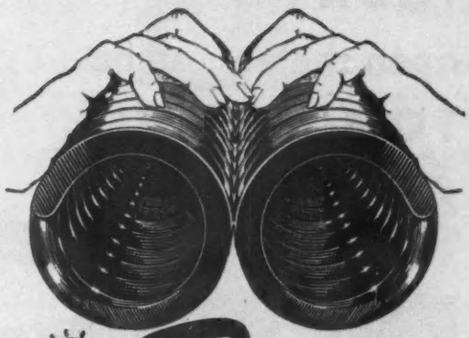

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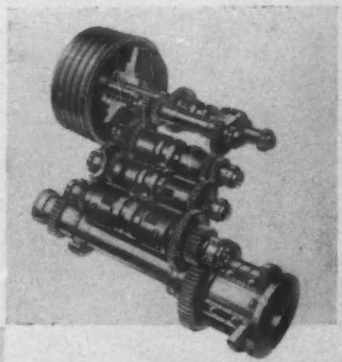
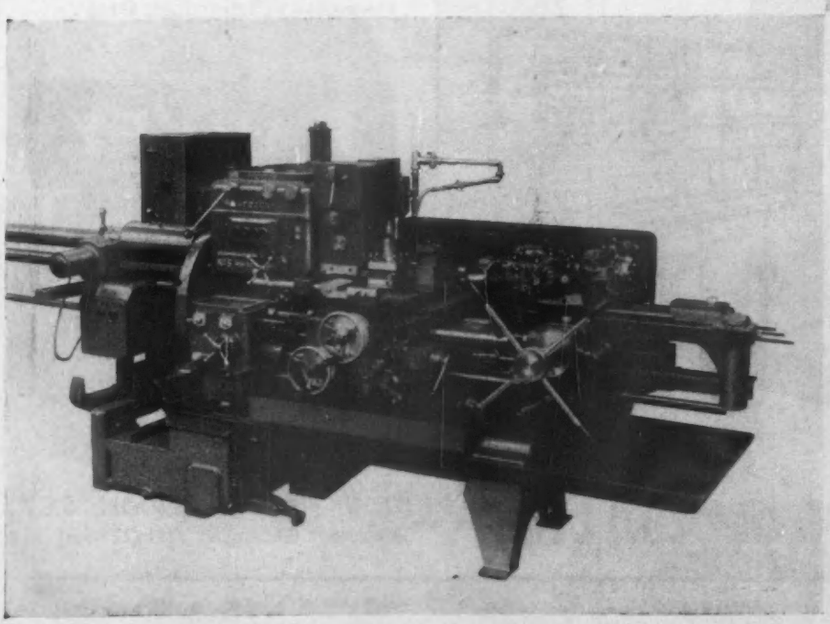


Shaft and gearing arrangement of power-operated Preoptive headstock. Hardened and ground gears close to bearings to minimise shaft deflection. All speed changes by multi-friction clutches. Multi-vee rope drive giving high efficiency.



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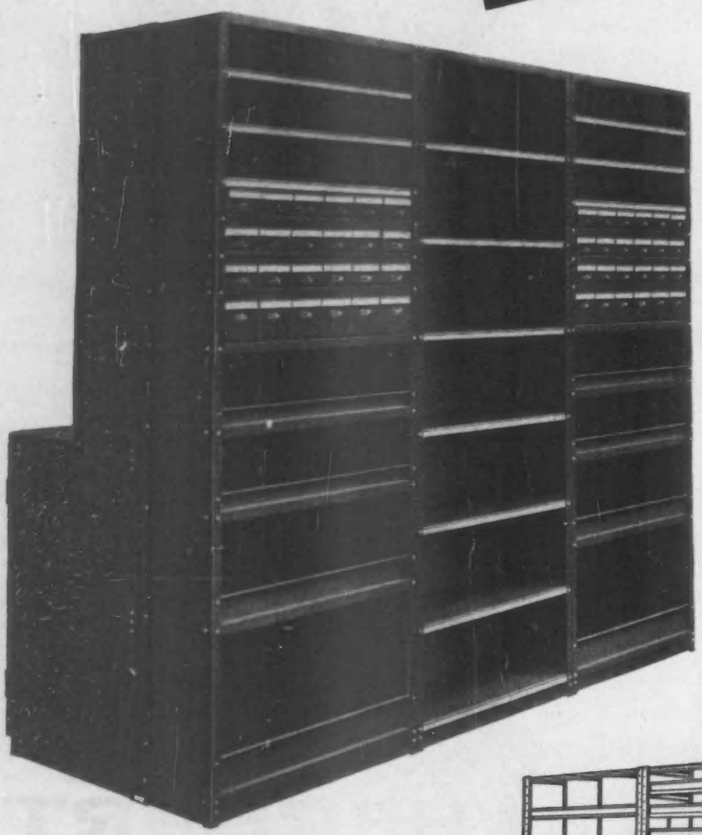

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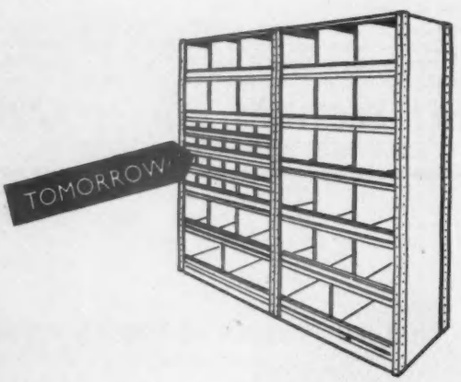

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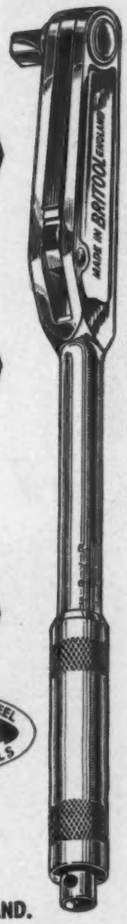

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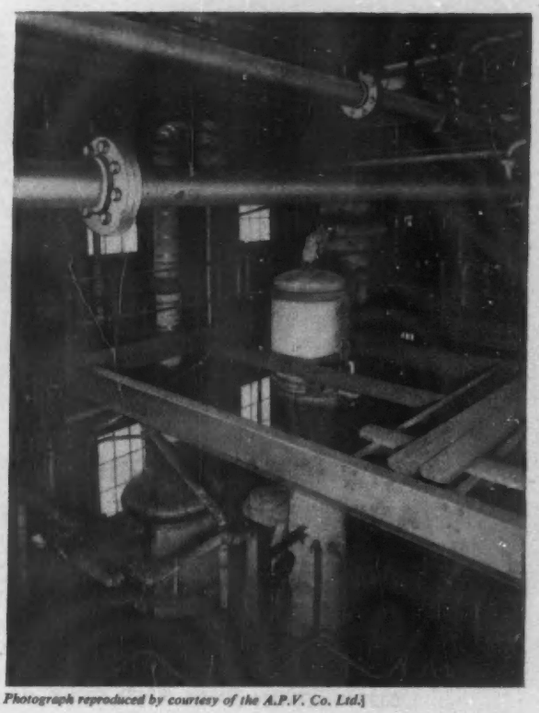

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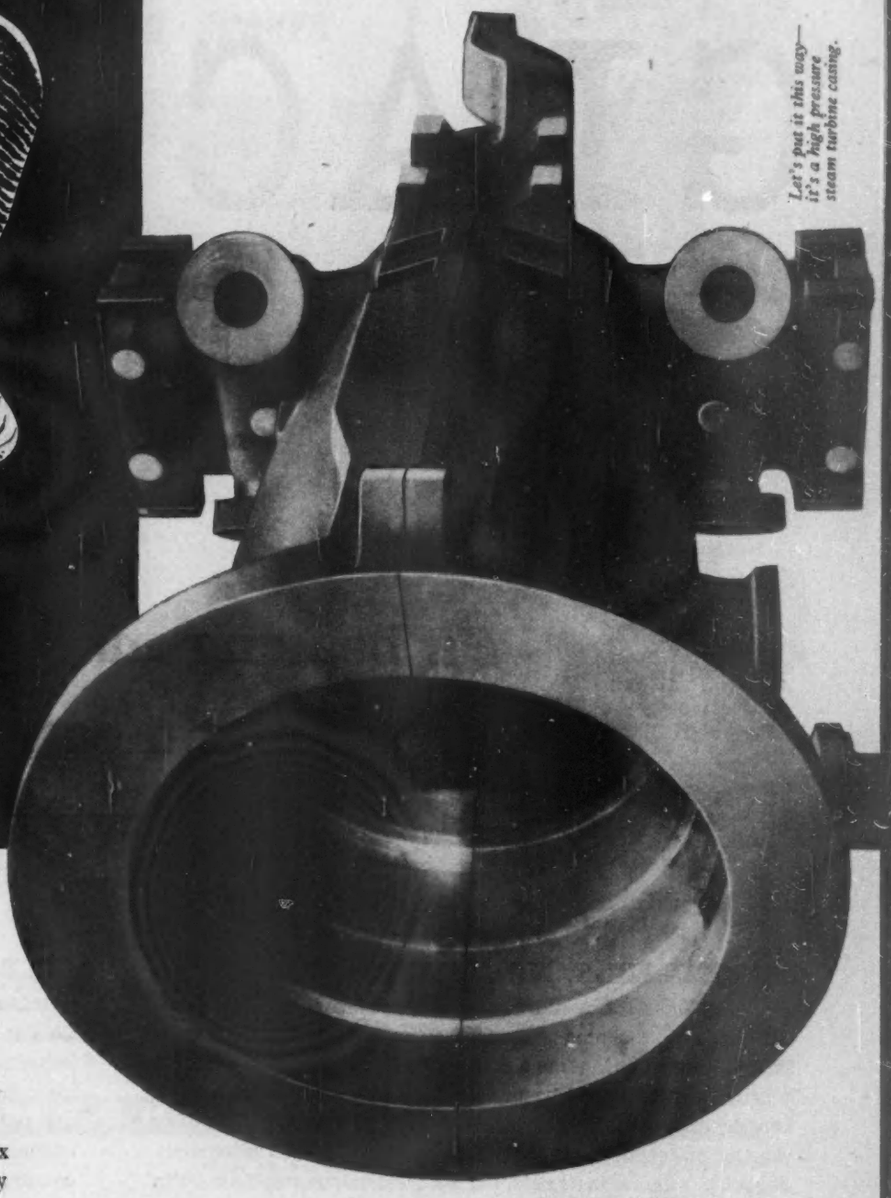
Brown Magic



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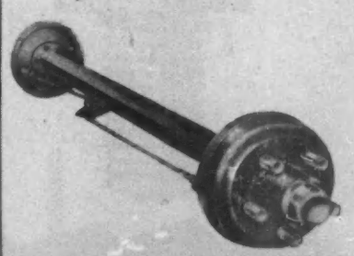

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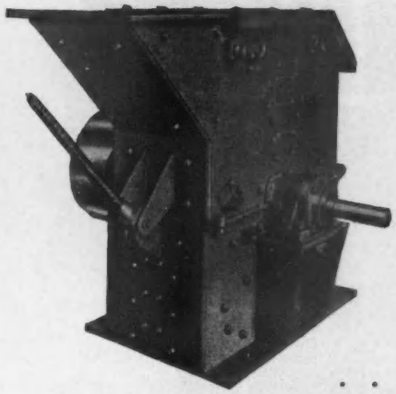

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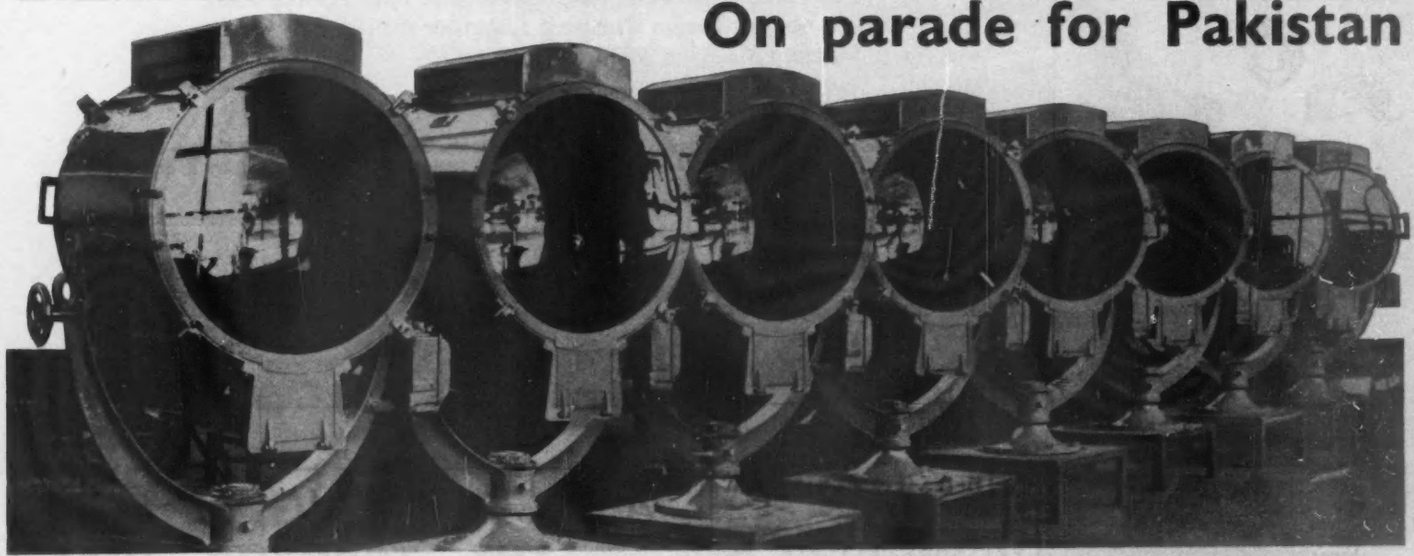

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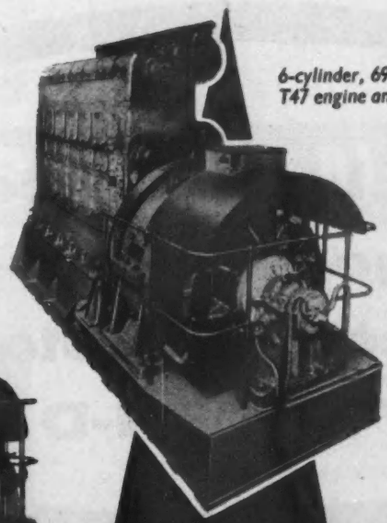

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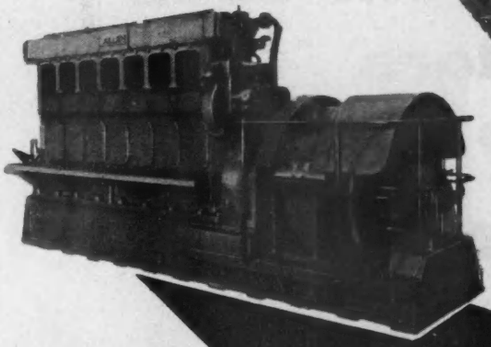

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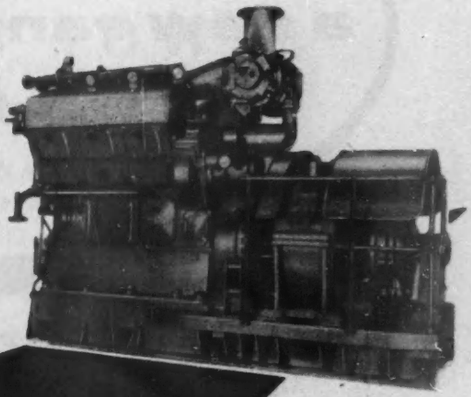

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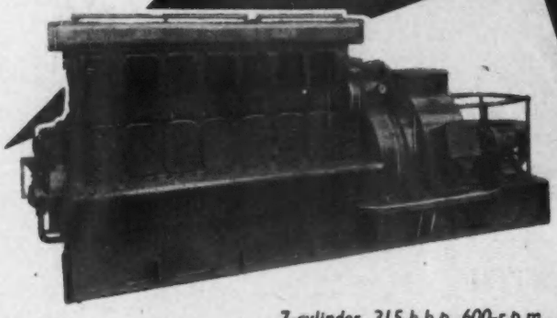

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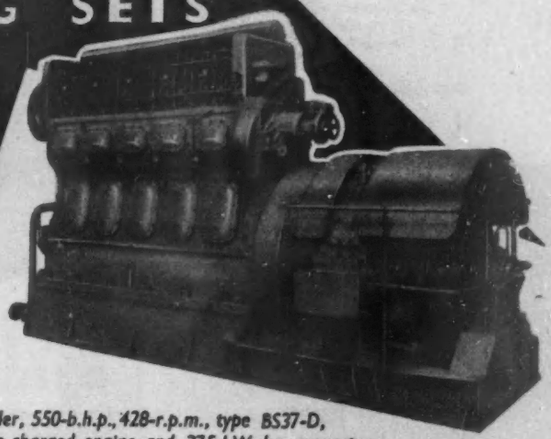

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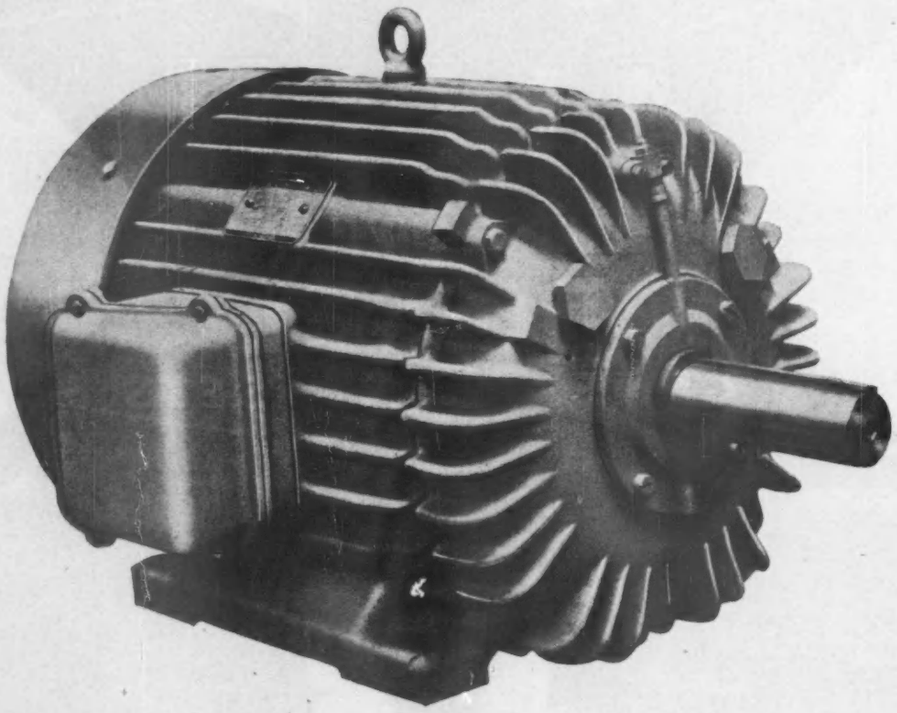

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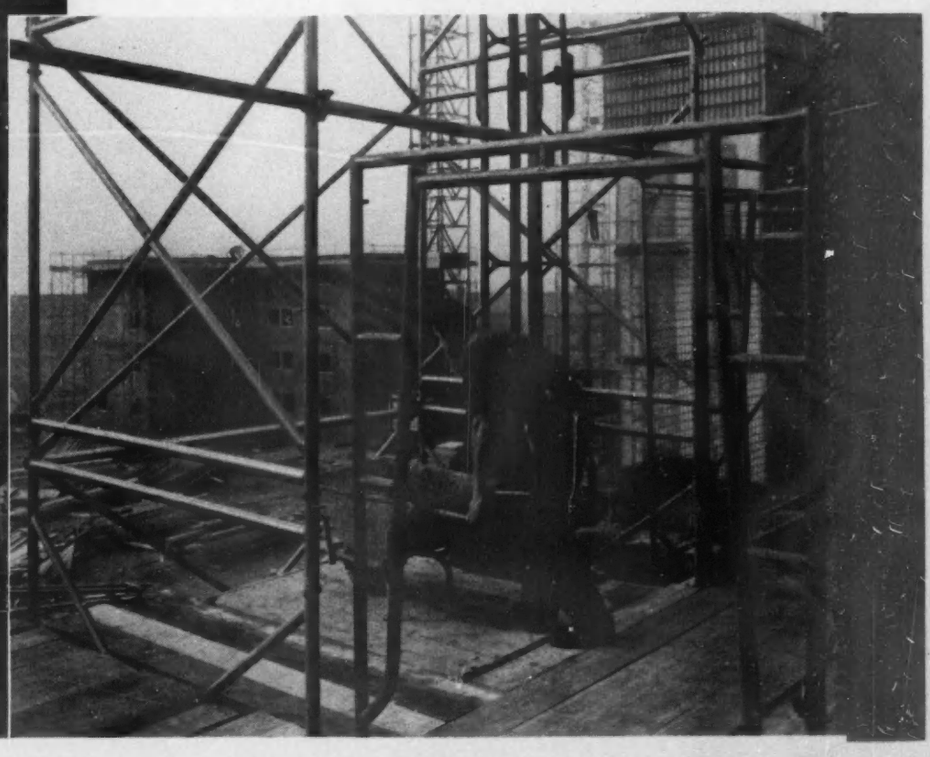

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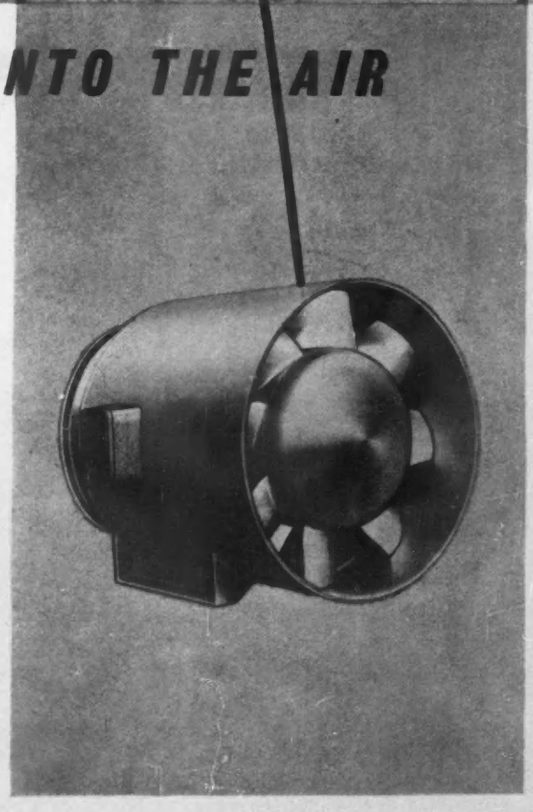

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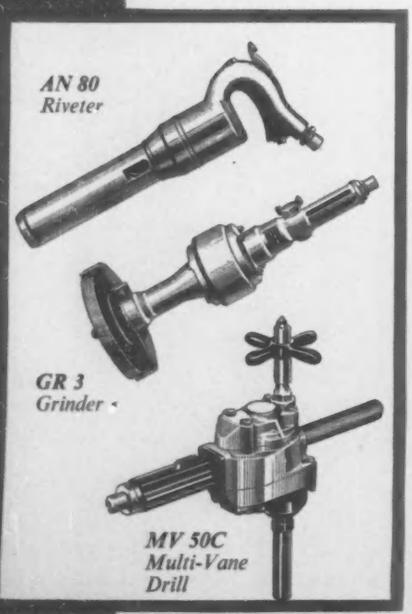

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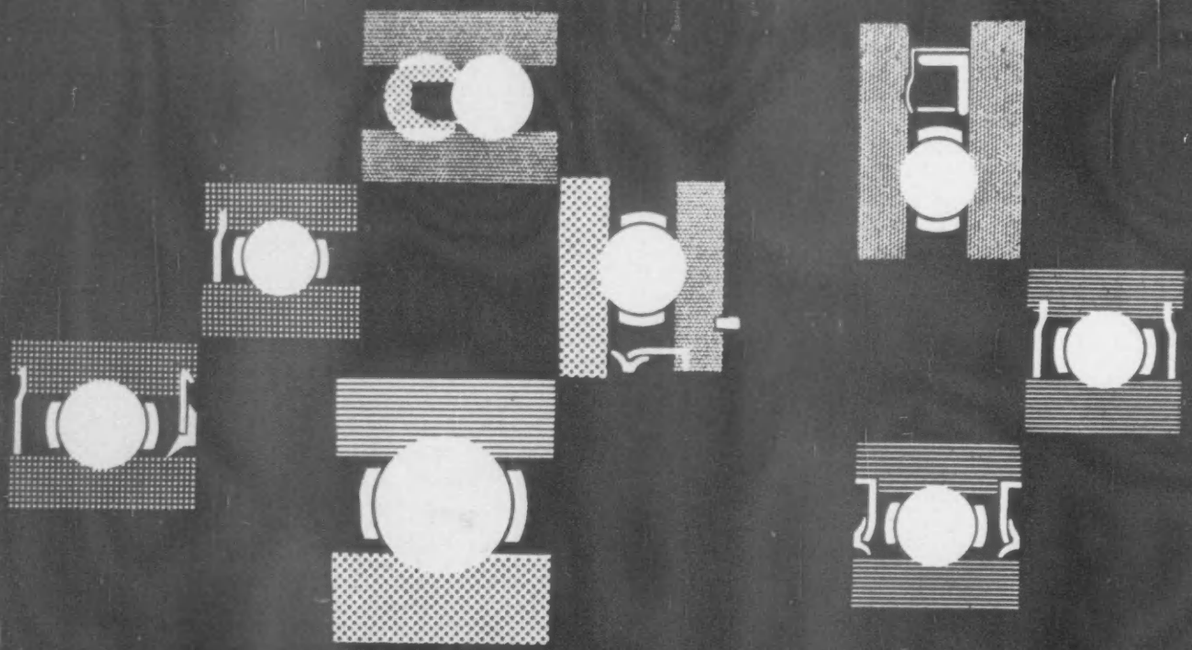

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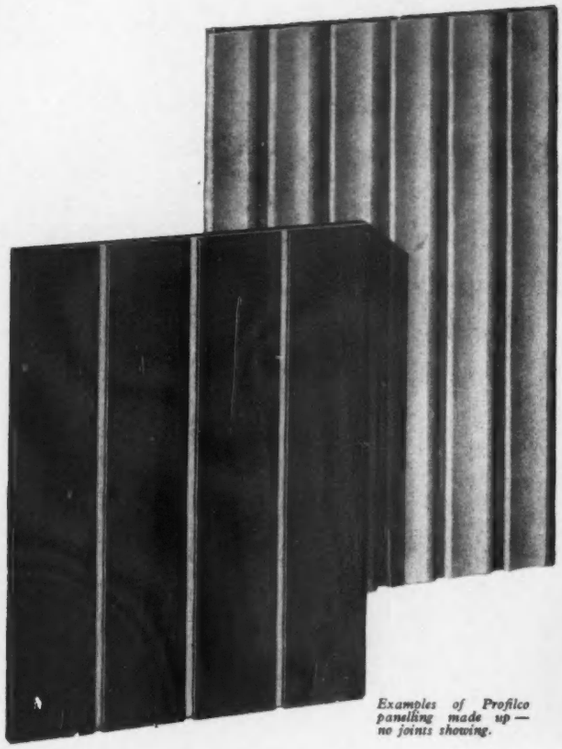

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Mahogany throughout 333.
Obeche face, Mahogany core 311.
Mahogany face, Obeche core 313.
96" long, 3¼" wide.

Obeche face, Mahogany core 315.
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Obeche face, Mahogany core 324.
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96" long, 3¼" wide.

Obeche face, Mahogany core 326.
Mahogany face, Obeche core 327.
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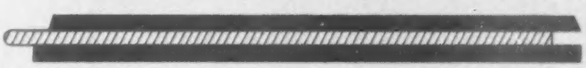

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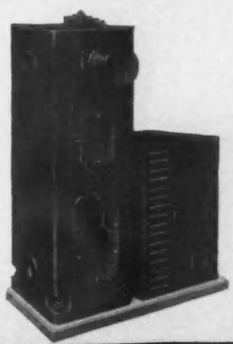

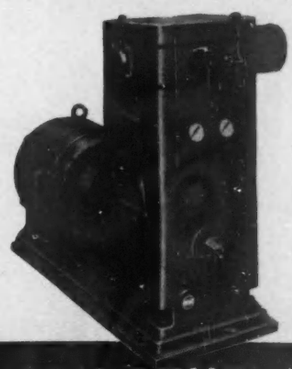

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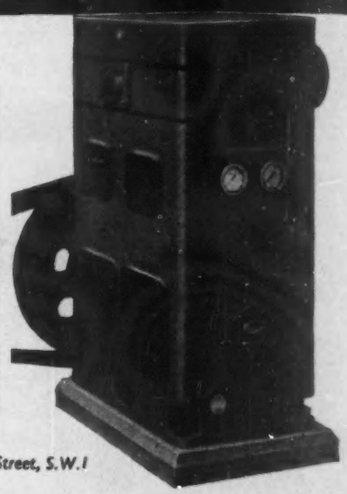

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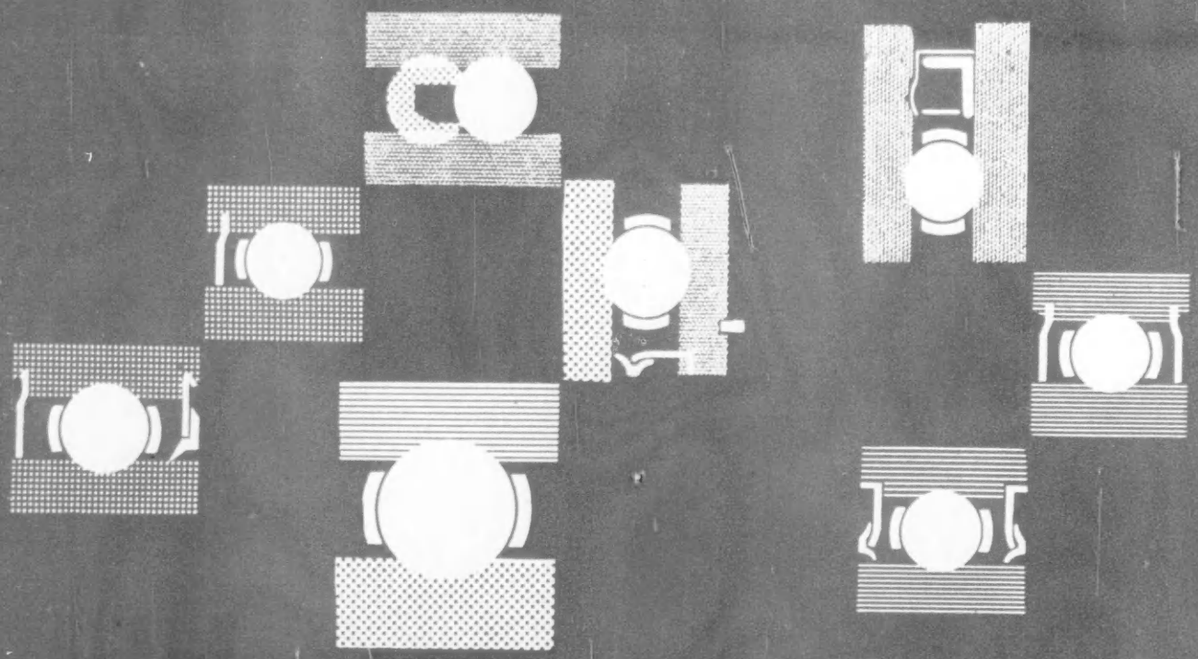

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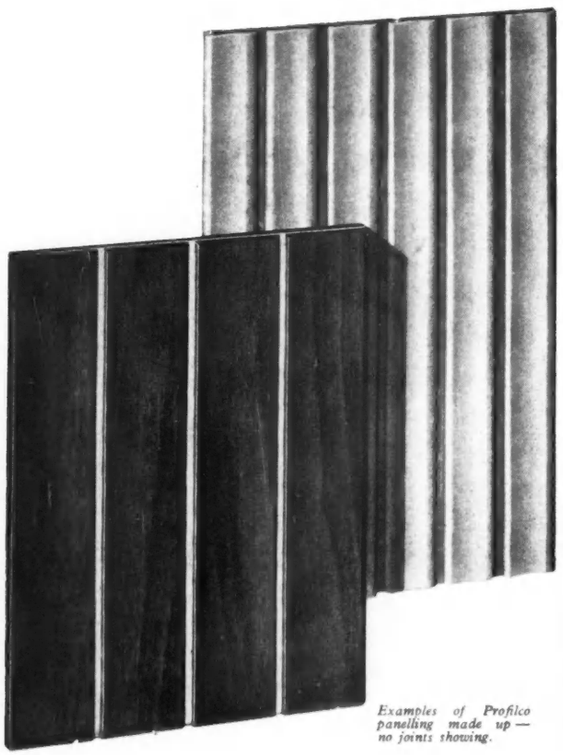


Examples of Profilco panelling made up — no joints showing.

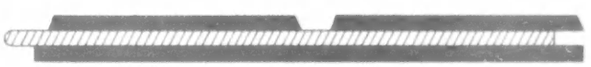
Distinctive panellings in decorative plywood

Below are actual-size sections, with alternative facings.

Mahogany throughout 333.
Obeche face, Mahogany core 311.
Mahogany face, Obeche core 313.
96" long, 3½" wide.

Obeche face, Mahogany core 315.
Mahogany face, Obeche core 317.
96" long, 3½" wide.

Obeche face, Mahogany core 324.
Mahogany face, Obeche core 325.
96" long, 3½" wide.



Obeche face, Mahogany core 326.
Mahogany face, Obeche core 327.
96" long, 3½" wide.

Mahogany throughout 310.
96", 84", 72", 60" long, 24" wide.

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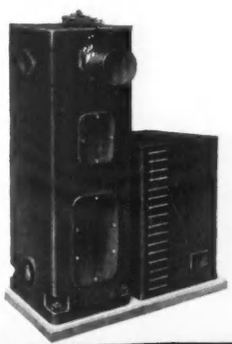

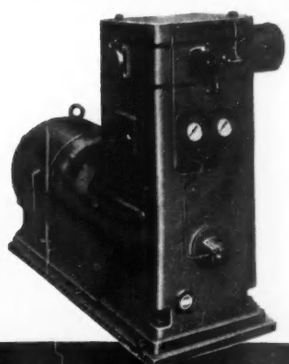

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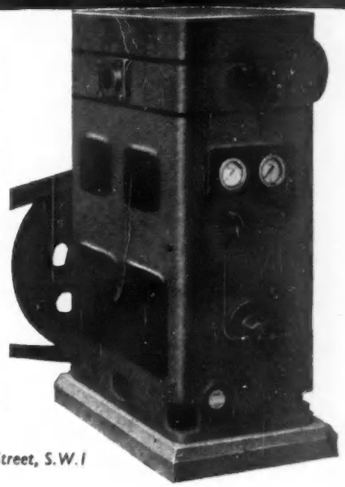

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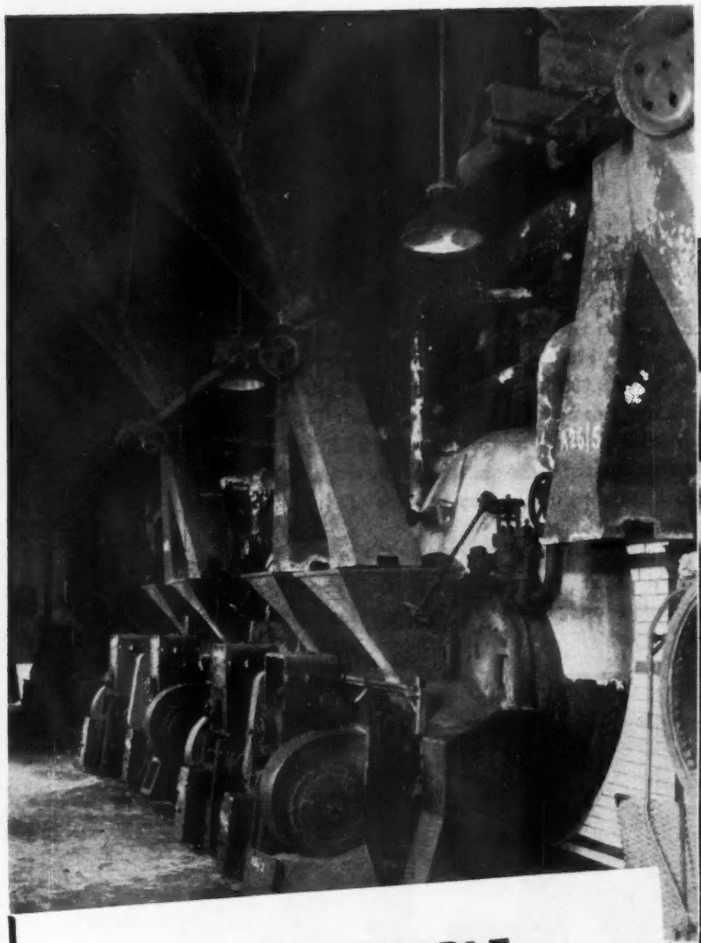

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Yarrow triple drum WATERTUBE BOILER, approximate dimension 12ft. 6in. high × 11ft. 6in. diameter × 10ft. deep. Working pressure 400 p.s.i., evaporation approximately 12,500 lb./hr.; with superheater 675 deg. Fah.

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Ruston Thermax VERTICAL MULTI-TUBULAR BOILERS, working pressure 120 p.s.i. Size No. 5 7ft. diameter × 18ft. high, approximate evaporation 4,500 lb./hr., from and at 212 deg. Fah. TWO Size No. 45 6ft. 6in. diameter × 15ft. high, approximate evaporation 3,600 lb./hr. from and at 212 deg. Fah. THREE Size No. 35 6ft. diameter × 15ft. high, approximate evaporation 2,700 lb./hr. from and at 212 deg. Fah.

All the above boilers complete with full complement of standard fittings and mountings.

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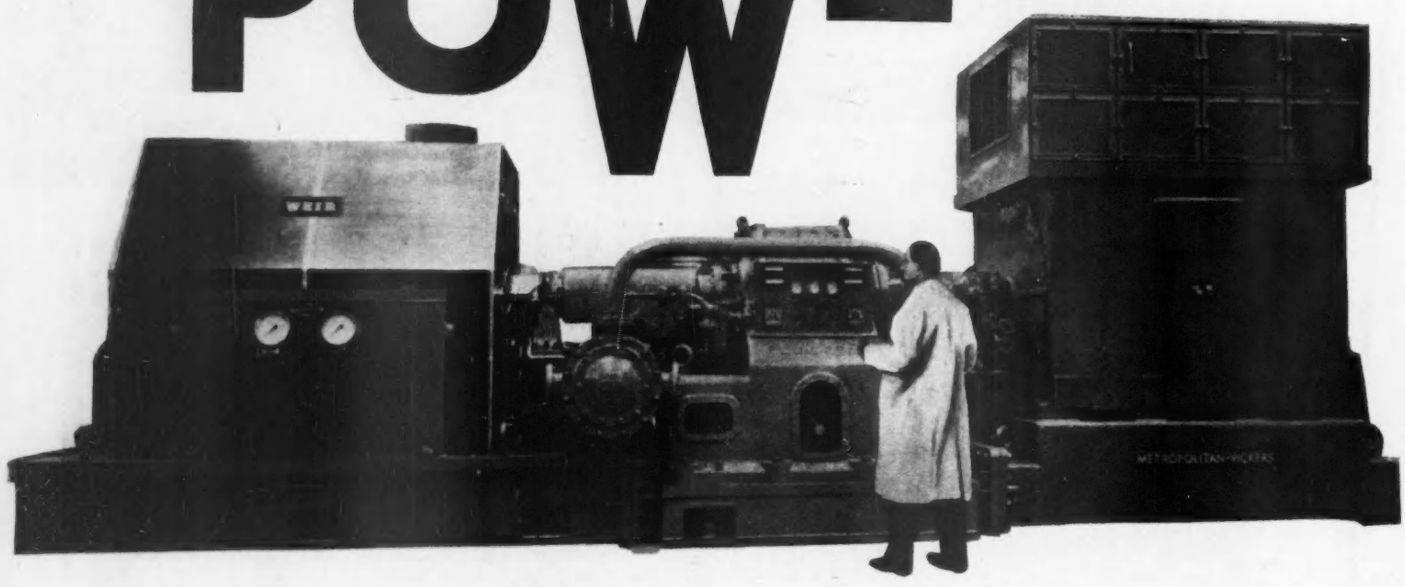

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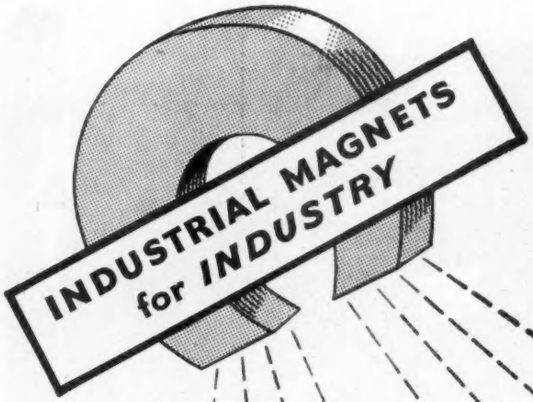

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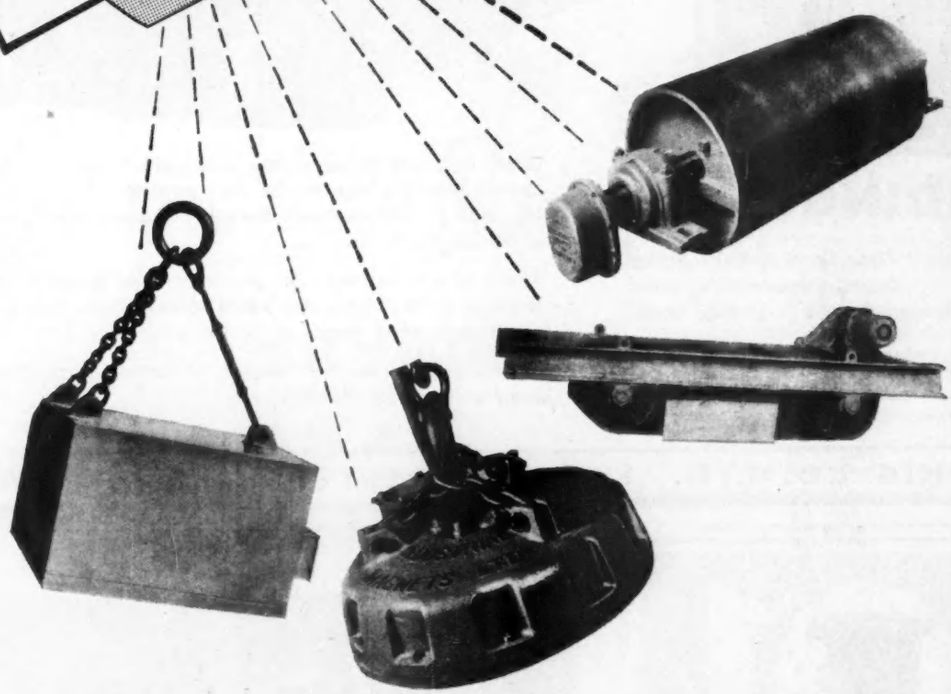

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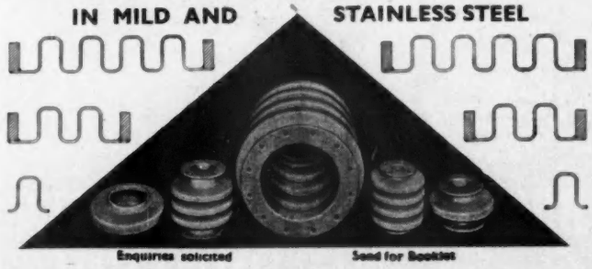

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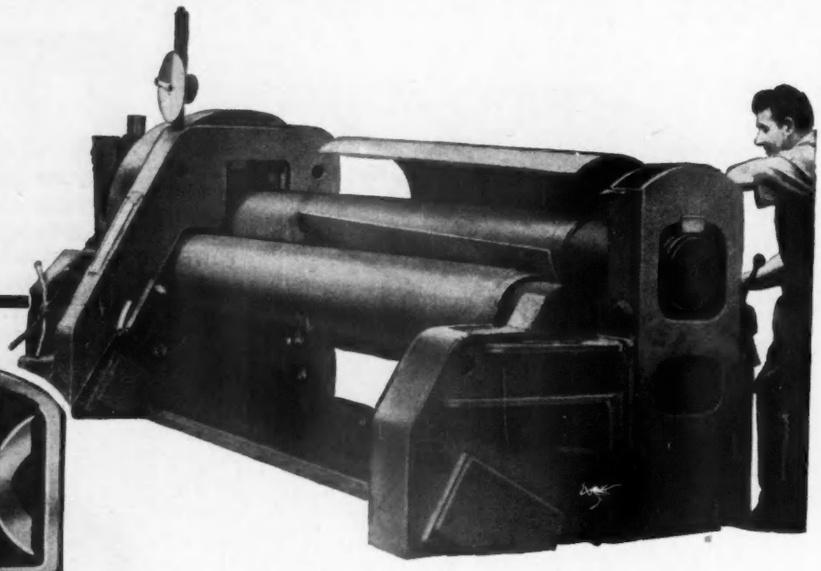

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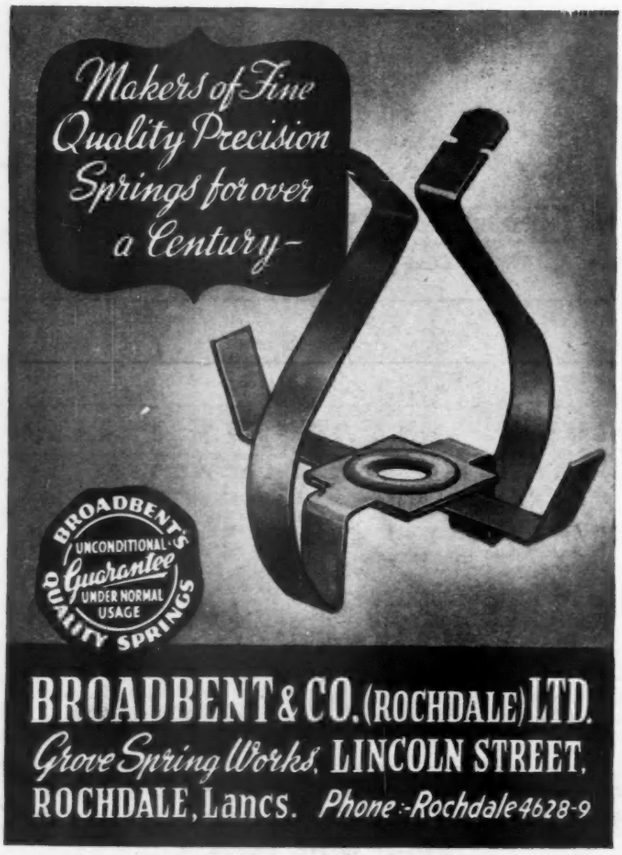

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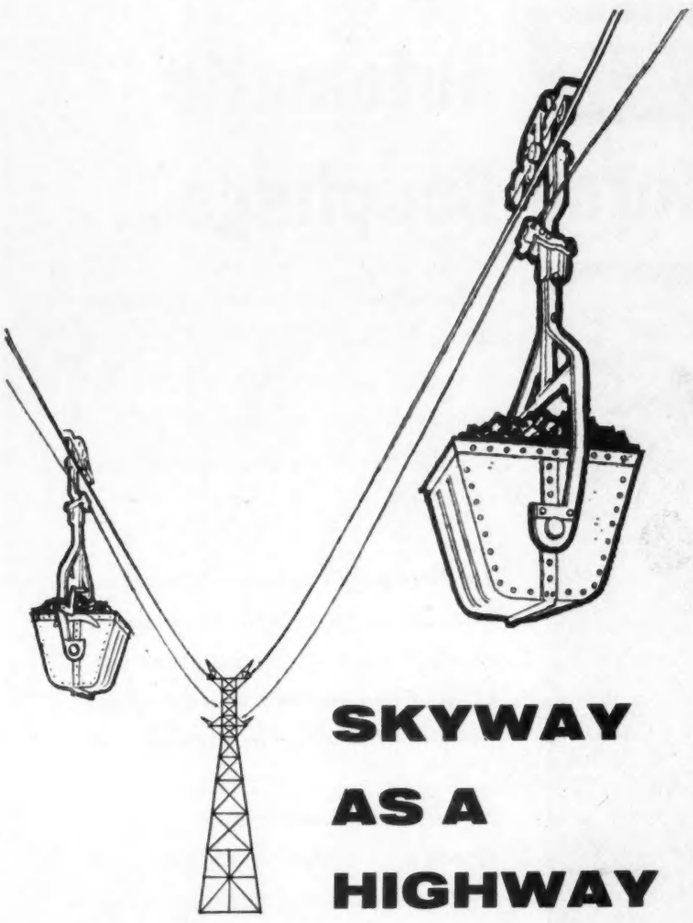

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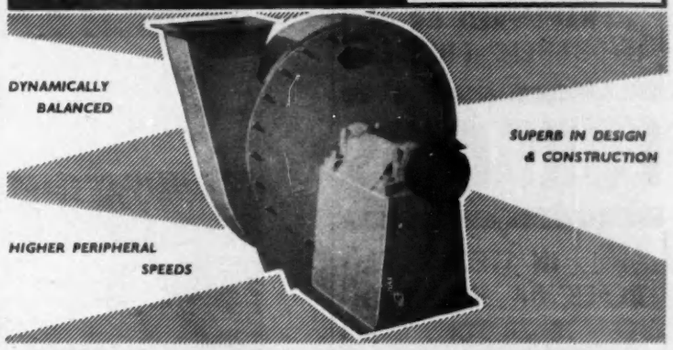

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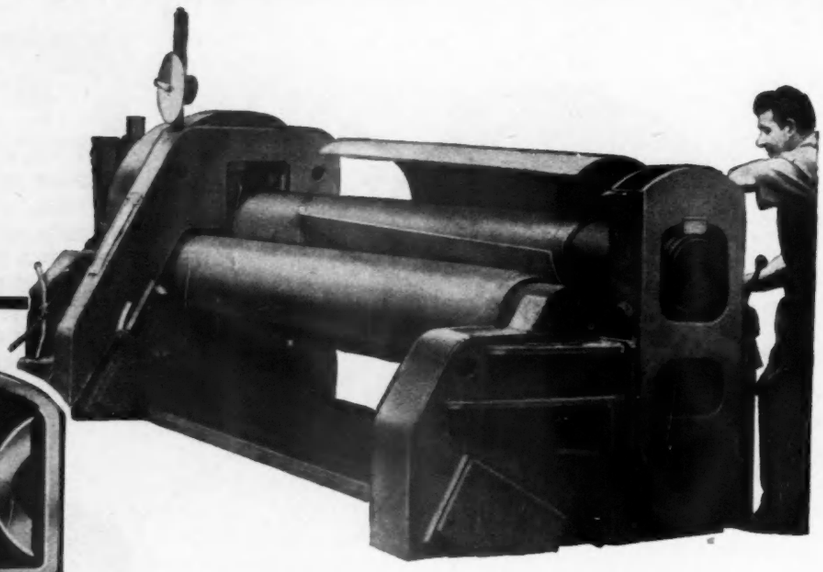

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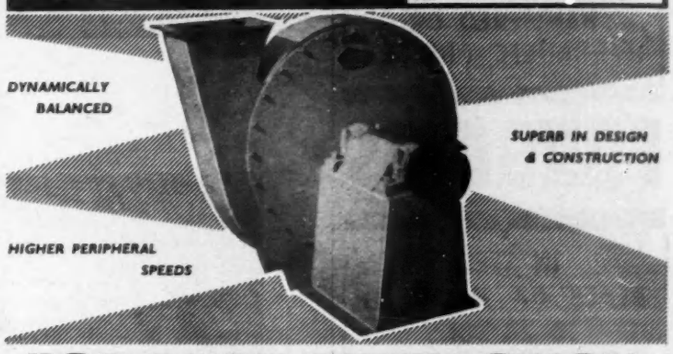

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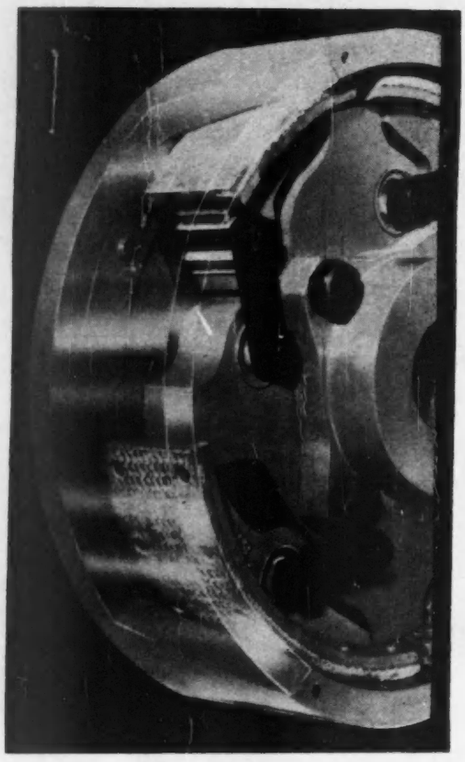

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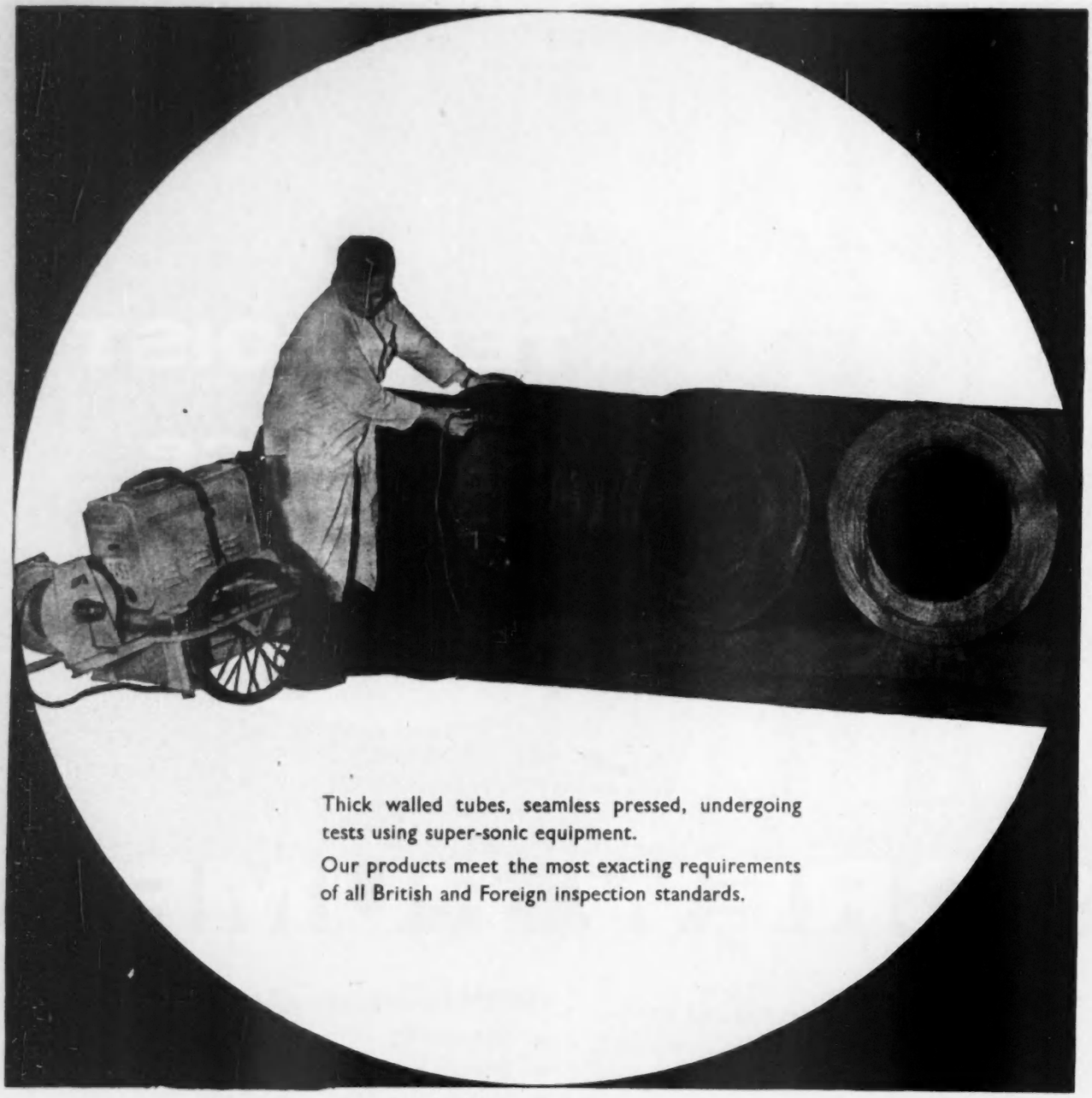

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The choice of the most suitable one of these, coupled with the selection of the right material, ensure the most economical manufacture of our vessels and tubes. Our works are equipped to handle ingots up to 120 metric tons for making these products.

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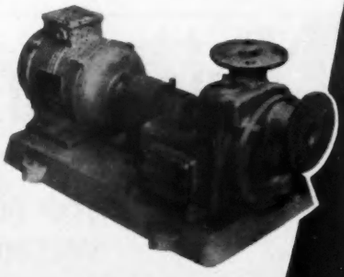
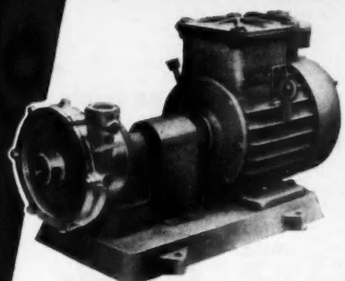


1" AUTOSTART self priming pump with open type impeller for passing small solids in suspension, no internal valves or fine clearances. Capable of suction lifts of 20 feet and heads up to 60 feet. Fitted exclusively with mechanical shaft seals.

STAINLESS STEEL PUMPS

FOR CORROSIVE LIQUIDS ACIDS CHEMICAL SOLUTIONS



1" centrifugal pump fitted with mechanical seal and coupled to flame proof motor. Other types available where gland packing is specified. Pump sizes; up to 1½" screwed BSPT, and 2" flanged BSS'D'

Also available: *Glandless diaphragm pumps constructed of cast iron, bronze or ebonite lined cast iron for pumping corrosive and abrasive liquids.*

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GANTRIES

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ALLEN & Co (ENGINEERS) LTD.
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W. BARNS & SON (HOLLOWAY) LTD. (Successors to W. BARNS & SON) ESTABLISHED 1860
Globe Works, Queensland Road, Holloway, N.7. Telephone: NORTH 3347/8. Telegrams: Perforation Holway, London

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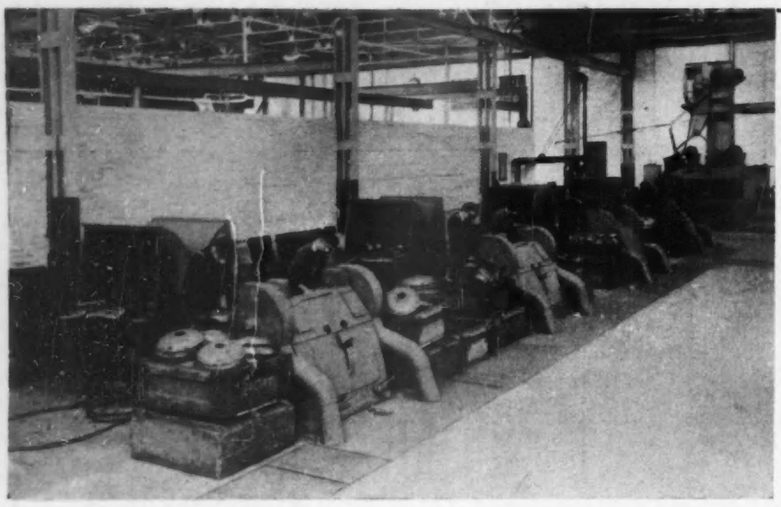

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IN THE NEW DRESSING SHOP OF

THE HILL TOP FOUNDRY CO., LTD.
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includes

14 "DUSTROL" Fettling Benches
(REG'D)

together with Hill Top 3 speed grinders incorporating B.S.C.R.A. hoods with all ducts underground and discharging to a wet collector with automatic sludge discharge.

We can supply ANY TYPE OF COLLECTOR, WET OR DRY, and so are in a position to give unbiased advice on the best system of collection to solve your particular problem.

"DUSTROL" Fettling Benches are designed and made solely by us. . . . . : .

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SPECIALISTS IN DUST AND FUME REMOVAL FOR NEARLY 40 YEARS

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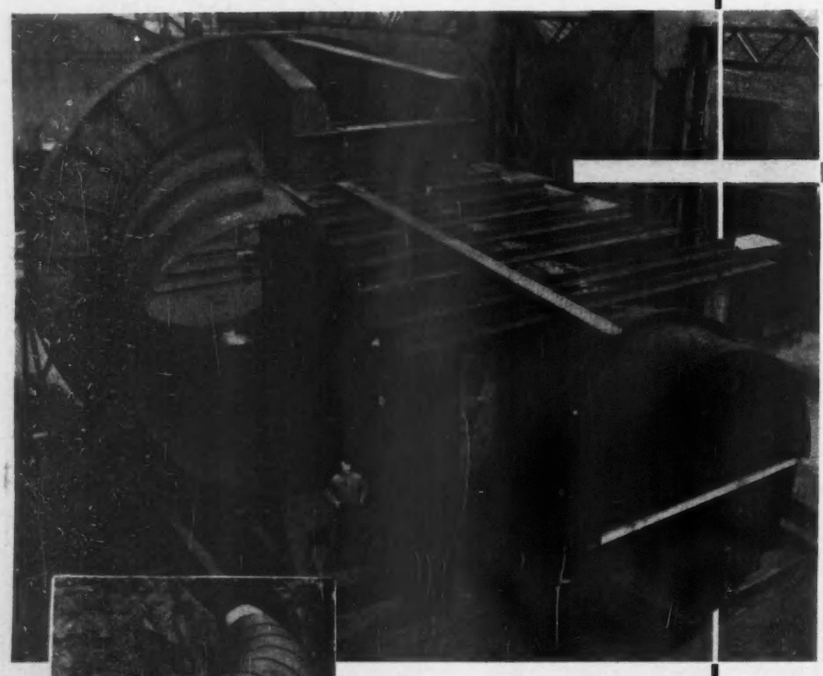

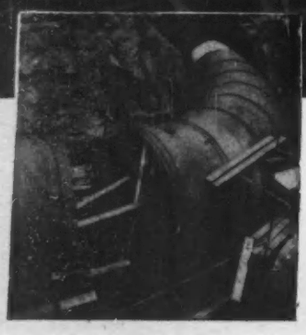

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Telephone: IBROX 1135

LONDON: CLUTHA HOUSE, 10 STOREY'S GATE, WESTMINSTER, S.W.1.

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Whether it be a single shape,
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STEAM · OIL · AIR · GAS · HIGH PRESSURE HOT WATER

For PRESSURES UP TO 100 P.S.I. TEMPERATURES UP TO 900° F.

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GLOBE VALVES *are the answer*

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THE STAINLESS STEEL CLACK AND SEAT GIVE MAXIMUM PROTECTION TO THE VALVE FACES WITH NEGLIGIBLE PRESSURE DROP.

SUITABLE FOR STEAM, GAS, OIL, AIR AND HIGH PRESSURE HOT WATER.

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IMMEDIATE DELIVERIES ARE AVAILABLE FROM ANY OF OUR 9 BRANCHES

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MORE Schieldrop Industrial Oil Burners are used by

MORE and more leading engineers and

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IN GREAT BRITAIN **MORE** than any other make

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HIGH QUALITY ENGINEERING & MACHINE TOOL CASTINGS

HEAT & WEAR RESISTING UP TO 10 TONS also in SPHEROIDAL GRAPHITE IRON & STEEL

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Comprehensive stocks of Joists, Channels, Angles, etc. Also Plates, Galvanised Sheets (flat and corrugated) for Engineers, Builders. Dexion Slotted Angle — large stocks kept. Reinforcing Bar Division, Cutting, Bending and fixing.

ENGINEERING

Keenest quotations given for ferrous and non-ferrous castings and all your general and heavy engineering requirements.

A LARGE FLEET OF MOBILE CRANES

Available at all times, 6-ton capacity, 40 ft. lifts. Heavier loads tackled by two or more cranes used together.

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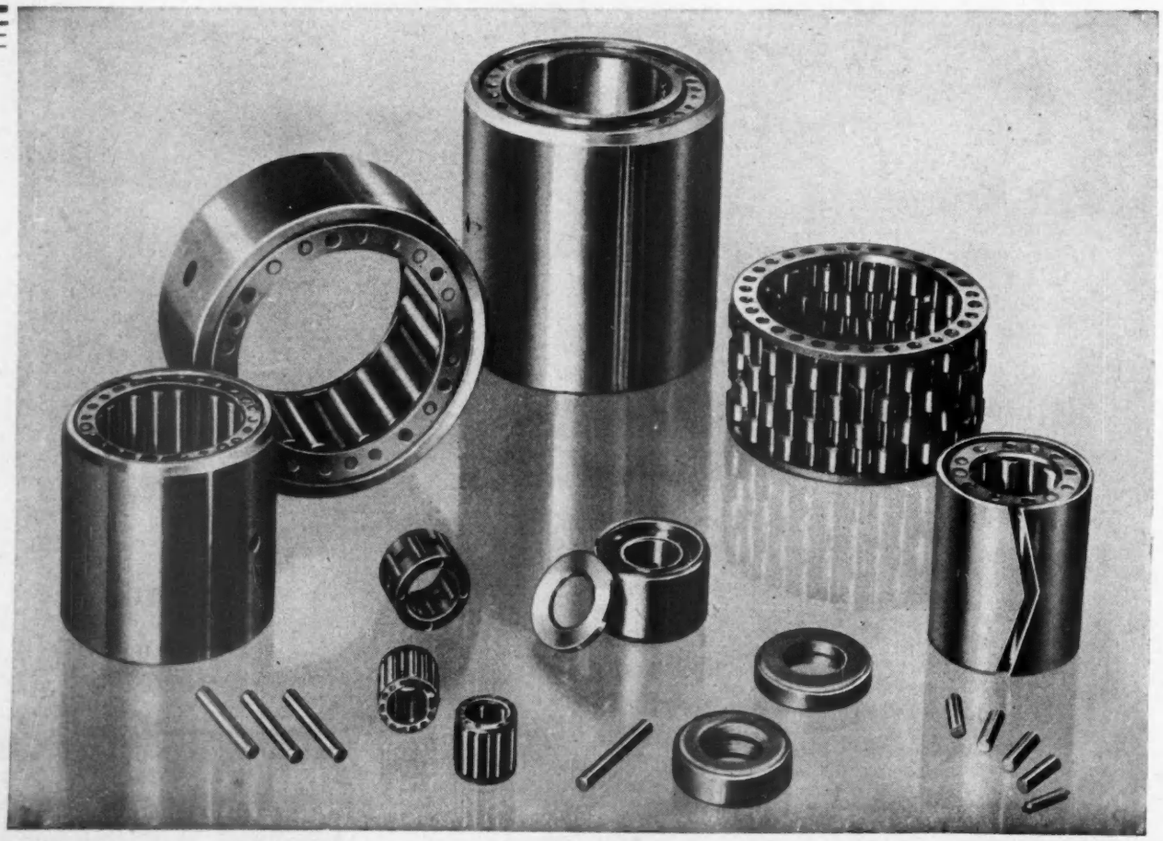
Send today for Comprehensive Catalogue



Blackwell Bearings Ltd. TEWKESBURY, GLOS., ENGLAND *Telephone:* TEWKESBURY 2018-9 *Telegrams:* WINWELL

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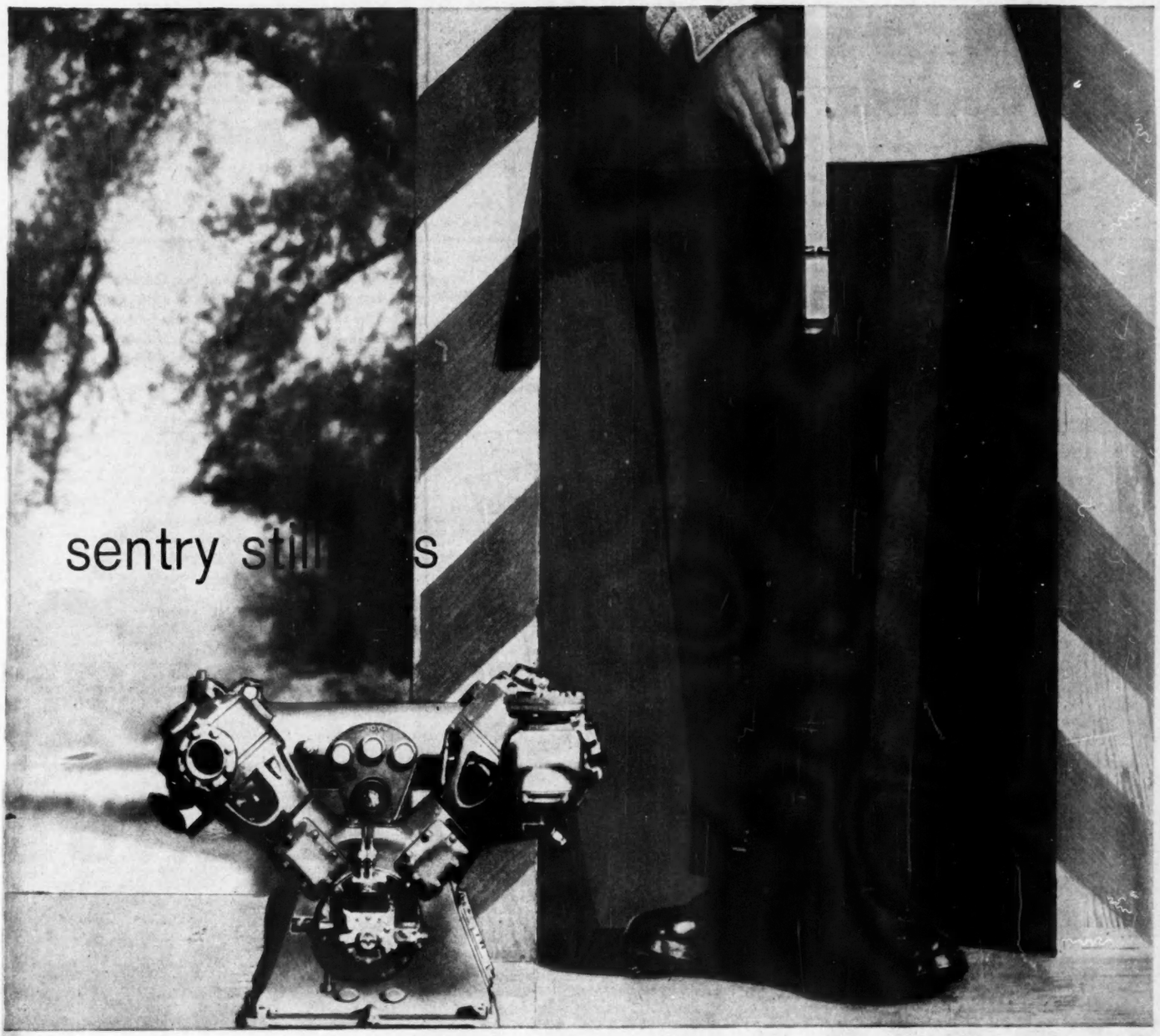

the Joy WN112 stationary compressor

Vibration does not distinguish the on and off duty periods of this compressor. Only the subdued hum of industrious efficiency comes from this well-balanced mechanism. Disciplined by JOY design and manufacture, the WN-112 parades a number of impressive features which you may read about in publication AD/6—gladly sent on request.

7 Harley Street, London, W.1

AIR POWER
JOY-SULLIVAN LTD
DIVISION

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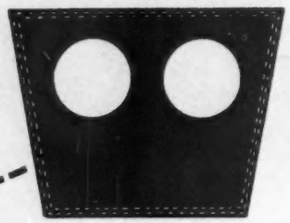
the GROMMET story



4 good reasons for fitting BTR High Test **V-BELTS**

1 HIGHER HORSEPOWER

Grommet construction makes the most efficient use of high tensile cords to produce the strongest V-belts yet made. For grommet construction ensures that *all* the cords of a belt share the load *equally* — which is the condition for maximum transmitting efficiency. Furthermore, a grommet, being an endless loop of high tensile cords, has no joints to weaken the belt, no overlapping sections to stiffen it.

2 MORE GRIPPING POWER

Grommet construction ensures that the belt exerts full driving grip on the walls of the pulley groove, for there are no central cords to dip and 'dish' the belt, pulling it away from the walls under load. This extra driving grip allows heavier loads and prevents belt slip.

3 MORE OUTPUT FOR ELECTRICITY CONSUMED

Despite its superior strength, a grommet is the most flexible V-belt load carrying device yet developed. Thus the belt runs cool and absorbs minimum energy in flexing around the pulleys. This saving in power appears in extra pay-load for electricity consumed.

4 LONGER BELT LIFE

Operating with a higher safety factor than ordinary V-belts, BTR grommet V-belts last longer because they are stronger and also because being so flexible they are subject to little strain in flexing round the pulleys.

BTR ENGINEERS IN RUBBER

HIGH TEST GROMMET V-BELTS

Patented in Great Britain by BTR Patent No. 567406

BTR Industries Ltd HERGA HOUSE, VINCENT SQUARE, LONDON S.W.1 *Telephone: VICtoria 3848*

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HYDRAULIC PRESSINGS AND ROLLED RINGS

by

Caston Barber

HYDRAULIC PRESSINGS

Producing Hemispherical ends and other hydraulic pressings of up to 3 feet in diameter, Caston Barber have a wide range of existing tools, a list of which will gladly be sent on request. Dished and Flanged cylinder ends, with or without inspection openings, are also manufactured to order.

ROLLED RINGS

Caston Barber produce rings from a wide range of flat and angled sections of mild or stainless steel. Flanged rings and washers are supplied to meet all specifications and in many cases the rings are flash butt welded.

Caston Barber have the equipment and the experience to meet your requirements.

Do not hesitate to write or telephone your enquiries to:

CASTON BARBER, 47 TABARD STREET, LONDON, S.E.1 Telephone: HOP 1991/5

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CLASSIFIED ADVERTISEMENTS

PUBLIC APPOINTMENTS · SITUATIONS VACANT · TENDERS · EDUCATIONAL · BUSINESSES and PREMISES · BUSINESS OPPORTUNITIES PATENTS · MISCELLANEOUS · AGENCIES · DIRECTORS · PARTNERSHIPS

Lineage Rate. 4/6 per line of approximately 6 words. Minimum 18/- **Inch Rate.** 54/- per single column inch and pro rata. 12 lines to 1 inch.

There are reduced rates (i.e., not on a pro rata basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £29 10s. ½-page £54. Full page £100.

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Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an Illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/- which includes forwarding of replies.

Copy Dates. Tuesday for publication on Friday of the same week. If proofs are wanted, copy is required on Thursday for publication on Friday of the following week.

***Advertisements for publication should be addressed to :*—Classified Advertisement Dept., "THE ENGINEER," 28 Essex Street, Strand, London, W.C.2**

Urgent advertisements may be telephoned to CENtral 6565.

PUBLIC APPOINTMENTS

UNIVERSITY OF SYDNEY

LECTURESHIP/SENIOR LECTURESHIP IN ELECTRICAL ENGINEERING

Applications are invited for the above-mentioned position. Applicants should have good academic qualifications in Electrical Engineering, experience in the power field, and a working knowledge of electronic techniques. The successful applicant will take part in teaching, primarily in the field of electrical machines, and in research.

The salary for a Senior Lecturer is within the range £A2200–£A80–£A2600 per annum ; for a Lecturer within the range £A1500–£A90–£A2100 per annum. In each case cost-of-living adjustment will be allowed. The salary is subject to deductions under the State Superannuation Act. The commencing salary will be fixed according to the qualifications and experience of the successful applicant.

Under the Staff Members' Housing Scheme, in cases approved by the University and its Bankers, married men may be assisted by loans to purchase a house.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1.

Applications close, in Australia and London, on 19th February, 1960. E8331

WAR OFFICE

CHRISTCHURCH, HAMPSHIRE

ENGINEER

War Office require ENGINEER at Christchurch, Hampshire, for duties concerned with development and testing of construction plant (tractors, scrapers, graders and cranes).

Qualifications : A.M.I.Mech.E. or equivalent. Design experience in some branch of mechanical engineering and experience in use and operation of road-making machinery in general and in particular machines used in making and handling of bituminous materials, quarrying and concreting plant.

Salary range : £780–£1680, according to age and experience. Appointment not established but opportunities to compete for establishment may arise.

Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting C.847/9A. E8347

ROYAL BUCKINGHAMSHIRE AND ASSOCIATED HOSPITALS MANAGEMENT COMMITTEE

SUPERINTENDENT ENGINEER

SUPERINTENDENT ENGINEER required for five hospitals, totalling 565 beds, to be responsible for all engineering services and to co-operate with the Group Building Superviser, who is responsible for building maintenance. Applicants must have passed an examination in engineering technology and hold an approved qualification.

Salary scale in 20½–30 points group, i.e. £890 to £1045 per annum (increase pending). House available.

Further details available from the Secretary, 9, Bicester Road, Aylesbury, to whom applications, stating full details of qualifications, age and experience, and naming three referees, should be sent by 12th January, 1960. E8314

H.M. PRISON, WAKEFIELD, YORKS

CIVILIAN INSTRUCTIONAL OFFICER (FITTER MACHINIST)

Post at H.M. Prison, Wakefield, Yorks, for man at least 30 on 29th January, 1960. Qualifications : full apprenticeship plus at least 5 years' practical experience. Able to instruct in machine shop engineering. City and Guilds Certificate (or equivalent) and some teaching experience desirable. Salary £775 to £900. Prospects of pensionable employment. 44-hour week and holidays with pay. Quarters not provided.

Write Prison Commission, R.241/249, Horseferry House, Dean Ryle Street, London, S.W.1, for application form.

Closing date 15th January, 1960. E8368

PUBLIC APPOINTMENTS

DEPARTMENT OF MAIN ROADS, NEW SOUTH WALES, AUSTRALIA

CIVIL ENGINEERS

Applications are invited from Graduates (or Undergraduates in their final year) in Civil Engineering of a recognised British or Irish University, for appointment to the staff of the Department of Main Roads, New South Wales, the State Road Authority for construction of roads and bridges.

On appointment, applicants may be engaged at the Department's Head Office, Sydney, on the design of reinforced concrete and steel bridges, or on main road construction and maintenance either in the Metropolitan Area or the country.

Commencing salary according to qualifications and experience, will be within the range £A1185 to £A1410 per annum, with annual progression, subject to technical competence, to £A2095 per annum. Appointees will be eligible to contribute to the State Superannuation Fund after six months.

Appointee's full fare from England to Australia will be met by the Department, subject to a three years' service guarantee bond being completed. Appointment will be subject to passing a medical examination and preference will be given to applicants not more than 30 years of age.

Applications should be made on forms obtainable from the Agent General for New South Wales, 56, Strand, London, W.C.2. When replying, please quote this paper. E8356

GOVERNMENT OF THE FEDERATION OF RHODESIA AND NYASALAND

DEPARTMENT OF CONSERVATION AND EXTENSION : NORTHERN RHODESIA

MINISTRY OF AGRICULTURE

VACANCY : MECHANICAL ENGINEER

Applicants must hold a recognised Degree in Mechanical Engineering/and/or be a Corporate Member of the Institution of Mechanical Engineers, and should have experience in workshops and field organisation of plant and equipment. Experience in works costing and stores control will be an added recommendation.

Duties will include the organisation and control of the Department's fleet of heavy crawler tractors, ancillary equipment and vehicles, as well as the workshops and stores. He will also be required to give advice on mechanical matters.

Salary on the scale £1785–£1864 16s.–£1942 10s. Government housing while serving in Northern Rhodesia will be provided at a rental not exceeding 12½ per cent of basic salary.

Application forms and further details from the Secretary (R), Rhodesia House, 429, Strand, London, W.C.2. Closing date : 31st January, 1960. E8344

GUILDFORD, GODALMING AND DISTRICT WATER BOARD

APPOINTMENT OF SENIOR ENGINEERING ASSISTANT

Applications are invited for the appointment of SENIOR ENGINEERING ASSISTANT at a salary in accordance with Grade A.P.T. II (£765–£880 per annum).

Candidates should have had good experience in the general engineering work of a Water Undertaking, and have passed part of the Associate Membership Examination of the Institution of Civil Engineers.

The appointment will be subject to the National Scheme of Conditions of Service, the Local Government Superannuation Acts, and to the passing of a medical examination.

Applications, stating age, training, present and previous appointments and experience, and names and addresses of two referees, must be received by the Chief Engineer, "Branksome," Filmer Grove, Nightingale Road, Godalming, not later than Monday, 11th January, 1960.

Housing accommodation will be available for a married man.

H. C. WELLER,
Clerk to the Board.

Municipal Offices,
High Street,
Guildford. E8319

PUBLIC APPOINTMENTS

ROYAL NAVAL SCIENTIFIC SERVICE

SENIOR SCIENTIFIC OFFICERS AND SCIENTIFIC OFFICERS

SENIOR SCIENTIFIC OFFICERS and SCIENTIFIC OFFICERS required in following localities :

LONDON AREA : MECHANICAL ENGINEER with sound knowledge of basic principles of thermo and fluid dynamics, to carry out research programme in particular field of applied hydrodynamics. Experience in modern methods of design and research on axial flow compressors, turbines or pumps an advantage. MECHANICAL ENGINEER for research on precision gear design. MECHANICAL ENGINEER for work on propulsion problems. APPLIED MATHEMATICIAN for research of basic nature on stability of underwater vehicles ; knowledge of theoretical hydrodynamics and theory of control mechanisms an advantage. APPLIED MATHEMATICIAN or THEORETICAL PHYSICIST for acoustic analysis. APPLIED MATHEMATICIAN for work with electronic computers, with special reference to research into general underwater physical problems. ELECTRONIC PHYSICISTS for data handling and analysis problems. EXPERIMENTAL PHYSICIST for research in underwater acoustics. PHYSICIST interested in operation performance. CLASSICAL PHYSICISTS.

BALDOCK : PHYSICISTS or APPLIED MATHEMATICIANS for research in Metal or Quantum Physics.

PORTSMOUTH : PHYSICISTS with experience in field of microwave techniques. ELECTRONIC/ELECTRO-MECHANICAL ENGINEERS (experience in servo-mechanisms an advantage).

HASLEMERE : ELECTRONIC ENGINEER.

PORTLAND : PHYSICISTS or APPLIED MATHEMATICIANS for research in underwater acoustics. PHYSICISTS (general). ELECTRICAL ENGINEERS with advanced electronic design experience. MECHANICAL ENGINEERS. PHYSICAL CHEMISTS.

POOLE : CHEMICAL ENGINEERS. CHEMISTS with experience in rubber technology.

ROSYTH : MECHANICAL ENGINEER with experience in welding development. ELECTRONIC PHYSICISTS.

Candidates must normally be natural born British subjects of natural born British parents, with First or Second-Class Hons. Degrees or equivalent qualifications. S.S.O.s must have had three years' post-graduate experience and be not less than 26 years of age. Salaries (men) : S.S.O., £1233–£1460 ; S.O., £655–£1150 (London), somewhat lower in provinces.

Appointments unestablished (with F.S.S.U. benefits), but opportunities may occur for those under 32 to compete for established posts.

Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1 (quote A.483/9A). E7844

SHEFFIELD CORPORATION WATERWORKS

YORKSHIRE DERWENT SCHEME

APPOINTMENTS

Applications are invited for the following appointments on the staff of the Waterworks General Manager and Engineer (A. B. Baldwin, M.Eng.) :

(a) CHIEF ASSISTANT ENGINEERS, i/c Sub-sections. Salary : J.N.C. Scale "A" (£1215–£1445).—2 vacancies.

(b) SENIOR ENGINEERING ASSISTANT. Salary : A.P.T. V (£1220–£1375).—1 vacancy.

Successful applicants will be engaged upon the design and construction of the works of the Yorkshire Derwent Scheme, comprising a River Intake and Treatment Plant, a 40-mile Aqueduct, Service Reservoirs, Pumping Stations and Plant.

Applicants must be Chartered Engineers experienced in design and construction of major works. Previous employment on similar water supply schemes would be an advantage.

Appointments are superannuable and subject to medical examination and to the national conditions of service as applied by the City Council.

Applications endorsed with the title of the post applied for are to be forwarded to the undersigned by 23rd January, 1960, stating age, qualifications, past and present appointments (with dates and salaries), details of relevant experience and schemes engaged upon, together with the names of two referees.

JOHN HEYS,
Town Clerk.

Town Hall,
Sheffield, 1. E8379

PUBLIC APPOINTMENTS

EASTERN GAS BOARD

(AREA DRAWING OFFICE)

SENIOR DRAUGHTSMAN

Applications are invited for the position of SENIOR DRAUGHTSMAN in the Constructional Engineer's Department at Woodall House, Wood Green, N.22.

Applicants should possess a Higher National Certificate in Mechanical or Civil Engineering or similar qualification, and should be capable of designing and detailing steel and/or concrete structures. Previous experience in designing pipe work for the installation of Gas Works or Chemical plant would be an advantage.

The commencing salary will be within Grades A.P.T. 9 to 11 (£862 to £1111 per annum) of the National Joint Council for Gas Staffs (Metropolitan) Salary Scales, according to qualifications, ability and experience.

The successful applicant will be required to pass a medical examination, and unless already subject to a Pension Scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Eastern Gas Board Staff Pension Scheme within six months of taking up the appointment.

Applications, giving age and other relevant particulars, should be sent to the Constructional Engineer, Eastern Gas Board, Woodall House, 658, Lordship Lane, Wood Green, N.22, to arrive not later than 30th January, 1960. (Adv. No. 8.)'E8339

AIR MINISTRY

EXPERIMENTAL/ASSISTANT EXPERIMENTAL OFFICERS

Air Ministry require EXPERIMENTAL/ASSISTANT EXPERIMENTAL OFFICERS in : (1) Soils Laboratory, Cardington, Bedford Ref. E 518/9A ; (2) Ruislip, Middlesex Ref. D 641/9A.

(1) Duties : To take charge of small soil survey teams engaged on foundation investigations for runways, buildings and other civil engineering works at airfields, &c., and to progress and supervise associated laboratory testing. Work requires ability to use Geological Survey maps and publications in interpretation of results of survey.

Qualifications : Higher School Certificate (preferably including geology) or H.N.C., or equivalent qualifications and wide experience in responsible capacity in connection with field surveys and associated standard laboratory tests for soils investigations.

(2) Duties : Experimental work in connection with installation, operation, adaptation and modification of radio equipment and aerials.

Qualifications : H.N.C. Elect. or equivalent qualifications and sound general knowledge of principles of radio ; practical experience of one or more ground radio systems employed in R.A.F., such as navigational aids, air/ground communications, long range communications or radar an advantage.

Salary : Scales, Cardington, E.O., £954–£1166 ; A.E.O., £382 10s.–£830 ; Ruislip, E.O., £1005–£1233 ; A.E.O., £397 10s.–£880.

Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting appropriate reference. E8346

H.M. BORSTAL, HATFIELD, DONCASTER, YORKS

CIVILIAN INSTRUCTIONAL OFFICER (MOTOR MECHANIC)

CIVILIAN INSTRUCTIONAL OFFICER (MOTOR MECHANIC) required for Vocational Training at H.M. Borstal, Hatfield, Doncaster, Yorks, for a man at least 30 on 29th January, 1960. Qualifications : Full apprenticeship in automobile engineering, plus at least 5 years' experience in Motor Vehicle Repair and Maintenance work. City and Guilds Certificate (or equivalent) and some teaching experience desirable. Ability to teach technical drawing and/or mathematics an advantage.

Salary scale : £775 to £900. Prospects of pensionable employment. 44-hour week and holidays with pay. Quarters not provided.

Write Prison Commission, R.241/230, Horseferry House, Dean Ryle Street, London, S.W.1, for application form.

Closing date 15th January, 1960. E8367

Classified Advts, continued on page 88

PUBLIC APPOINTMENTS

THAMES VALLEY WATER BOARD

APPOINTMENTS

Applications are invited from suitably qualified persons for the following posts :—

A.—CHIEF ASSISTANT ENGINEER

Salary : N.J.C. Scale " B "—£1285–£50–£1485. Must have a wide knowledge of waterworks administration and the design and construction of capital works for a large water undertaking.

B.—WORKS (PLANT) ENGINEER

Salary : A.P.T. V—£1220–£1375. Required for the design, installation and maintenance of pumping and treatment plant, switchgear, remote control systems, diesel and electrical prime movers, &c.

C.—DISTRIBUTION ENGINEER

Salary : A.P.T. V—£1220–£1375. Must have considerable experience of all kinds of main laying work, distribution networks, waste-detection, metering, &c.

D.—ENGINEERING ASSISTANT

Special Grade—£785–£1070. Preferably with some years' experience of water supply engineering.

E.—ASSISTANT CHEMIST AND BACTERIOLOGIST

Salary : A.P.T. II—£765–£880. This post should appeal to someone recently qualified who wishes to gain experience in the field of water examination and treatment.

Applicants for posts A, C and D should be Chartered Civil Engineers and for B Chartered Mechanical and/or Electrical Engineers—all with previous waterworks experience. Applicants for post E should hold an appropriate University Degree or an equivalent professional qualification.

The appointments are subject to the National Scheme of Conditions of Service, the provisions of the Local Government Superannuation Act, 1937–1953, and the passing of a medical examination.

Applications, stating age, qualifications and experience, together with the names and addresses of two referees, should be sent to the undersigned not later than January 12th, 1960.

G. F. DARLOW,
Clerk of the Board.

Town Hall,
Reading. E8380

SOUTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

REGIONAL ENGINEER'S DEPARTMENT

SENIOR ASSISTANT ENGINEERS

Applications are invited for the following appointments on the permanent staff of the Board generally in accordance with the Whitley Council conditions of service.

SENIOR ASSISTANT ENGINEERS (Heating and Ventilating) : The commencing salary will be at the minimum of the scale £1050 by £30 (3) by £35 (3) to £1245 p.a., plus London Weighting allowance of £50 p.a. (Scale under review). Applicants should be Corporate Members of the Institution of Mechanical Engineers and should be experienced in the preparation of specifications, drawings and estimates for large engineering installations in hospitals and large public buildings.

Applications, stating age, qualifications, experience, present appointment and salary, together with the names and addresses of three referees, should be sent to the undersigned at 40, Eastbourne Terrace, London, W.2, by not later than 11th January, 1960.

E. G. BRAITHWAITE,
Secretary.

E8366

HACKNEY HOSPITAL, LONDON, E.9

APPOINTMENT OF SENIOR ENGINEER

Applications are invited for the above appointment, which becomes vacant in March, 1960. Candidates must have passed an examination in engineering technology and should hold either the First Class Certificate of Competency in Marine Engineering or the Certificate of Service as First Class Engineer (Ministry of Transport and Civil Aviation), or the City and Guilds First Class Full Technological Certificate in Plant Engineering. Equivalent qualifications may be considered. The post is non-resident, but the successful candidate will be expected to reside within easy reach of the Hospital.

The salary scale is £770–£915 per annum, plus £20/£30 per annum London Weighting Allowance.

Applicants must have had practical experience, preferably in hospital, in the maintenance and operation of oil-fired boilers, steam plant and electrical generating plant.

Applications to be sent to the undersigned by 11th January, 1960, with full details of experience, qualifications, &c., and the names of two referees.

JOHN B. MANNING,
Group Secretary.

Hackney Hospital,
London, E.9. E8341

ENGINEER WORKS SERVICES ESTABLISHMENT OF SOUTHERN COMMAND

CORSHAM, WILTS

SHIFT ENGINEER

A vacancy exists for a SHIFT ENGINEER in the Engineer Works Services Establishment of Southern Command at Corsham, Wilts, commencing 22nd February, 1960. Salary : £590 (at age 28), rising by annual increments to £723 after 6 years. In addition, 6s. per day Shift Allowance is payable. Experience of diesel engines required. Some knowledge of refrigeration plant an advantage. Ex-R.N. Engine Room Artificer would be suitable.

Applicants should write, stating age, qualifications and experience, to C.R.E., North Wilts, Prince Maurice Barracks, Devizes, Wilts. E8359

PUBLIC APPOINTMENTS

WINWICK AND NEWCHURCH HOSPITAL MANAGEMENT COMMITTEE

NEWCHURCH HOSPITAL, CULCHETH, NEAR WARRINGTON

SENIOR ENGINEER

334 Beds

SENIOR ENGINEER required immediately, to be responsible to the Superintendent Engineer for the engineering and maintenance services at the above Hospital.

Candidates should be aged between 30 and 40 years and should possess one of the following qualifications :

Higher National Diploma in Mechanical Engineering ;

Higher National Certificate in Mechanical Engineering ;

First Class Certificate of Ministry of Transport or equivalent Naval Certificate ;

and should have completed an apprenticeship and be able to supervise steam heating, electricity, and water services, laundry plant and building maintenance.

Salary Scale : £640 by £20 (1) by £25 (2) by £30 (2) to £770.

(Capital development scheme in progress.)

Successful candidates will be required to live at or near the hospital, there is a possibility of a modern house on the hospital estate being available shortly. Applications, stating date of Birth, Qualifications, and full details of experience together with names and addresses of two referees to arrive no later than 14th January, 1960.

Group Secretary (Ref.: TE/147),
Winwick and Newchurch Hospital Management Committee,
Winwick Hospital,
Warrington. E8389

UNITED BIRMINGHAM HOSPITALS

DEPUTY SUPERINTENDENT ENGINEER

Applications are invited for the appointment of DEPUTY SUPERINTENDENT ENGINEER to these hospitals.

The successful candidate will be responsible to the Superintendent Engineer and, will, as deputy, be subject to those duties and responsibilities set out in Whitley Council Circular P.T.B. 51 for a Superintendent Engineer.

His duties will include responsibility to the Superintendent Engineer for the supervision of the engineering services and general maintenance of the Queen Elizabeth Hospital. Some experience in building construction and works maintenance would be an advantage.

Applicants should preferably be corporate members of the Institution of Mechanical Engineers or the Institution of Electrical Engineers or hold an equivalent professional qualification, but must in any event conform to requirements as to qualification laid down in Whitley Council Circular P.T.B. 91 for Superintendent Engineers.

This is a new appointment and salary will be on the scale £950 by £30 (5) to £1100. A house will be available, if required, upon terms to be agreed. Further information, may be had, if needed, from the Secretary to the Board of Governors, Queen Elizabeth Hospital, Birmingham, 15, to whom applications including names of three referees should be submitted by 18th January, 1960. E8400

RHODESIAN IRON AND STEEL COMPANY, LIMITED

POWER STATION SUPERINTENDENT

Applications are invited for the position of POWER STATION SUPERINTENDENT at the Company's Works at Redcliff, Southern Rhodesia, to take control of a small industrial power station with an initial generation of 2500kW together with blast furnace turbo-blowers, boiler plant and electrically driven compressors.

Minimum qualifications required—corporate membership of a recognised Institution of Electrical Engineers or Certificated Engineer.

Starting salary not less than £2000 per annum (inclusive).

The Company offers assisted passages for successful applicant and his family and liberal leave conditions ; pension and medical aid schemes. Married and single accommodation is available.

Applications should be addressed to Merz & McLellan, 32, Victoria Street, London, S.W.1, to reach them not later than 20th January, 1960. The appointment will be made very soon after that date. E8385

STOKE-ON-TRENT HOSPITAL MANAGEMENT COMMITTEE

BUCKNALL HOSPITAL

ASSISTANT ENGINEER

ASSISTANT ENGINEER required for Bucknall Hospital, Stoke-on-Trent (272 beds), to be responsible to the Group Superintendent Engineer for the supervision and general maintenance of boiler plant heating and electrical services. Ordinary national certificate in mechanical or electrical engineering or equivalent an advantage, otherwise sound practical experience essential.

Salary : £575 by £25 (5) to £700.

Applications with names of 2 referees to Group Secretary, Stoke-on-Trent Hospital Management Committee, Princes Road, Stoke-on-Trent. E8397

PUBLIC APPOINTMENTS

AIR MINISTRY

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS

Air Ministry require ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary : £805 at 25 to £1,095 at 34 or over, thereafter rising to maximum £1,260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. Five-day week with 4 weeks' 2 days' leave a year initially. Special allowance in addition to salary during overseas service. Qualifications and experience : (i) (a) Degree or equivalent diploma in electrical and/or mechanical engineering with at least 2 years' apprenticeship, or (b) Graduate or corporate member of I.E.E. with at least 3 years' apprenticeship, or (c) Graduate or corporate member of I.Mech.E., appreciable electrical engineering experience with at least 3 years' apprenticeship, and (ii) have been employed for minimum of two years with well-established engineering concern and gained wide experience in both electrical and mechanical engineering practice. Applicants must be natural born British subjects, aged 25 to 45. Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting D 555/9A.

E7944

RHODESIAN IRON AND STEEL COMPANY, LIMITED

BLAST FURNACE MANAGER

Applications are invited for the position of BLAST FURNACE MANAGER at the Company's Works at Redcliff, Southern Rhodesia.

The plant comprises 3 blast furnaces, capacities 110, 150 and 500 tons per day, ore handling plant, Head Wrightson electrostatic precipitator gas cleaning plant, 500 ton/day Simon-Carves sinter plant, pig casting machine and usual ancillary equipment.

Starting salary not less than £2400 per annum (inclusive).

The Company offers assisted passages for successful applicant and his family, and liberal leave conditions ; pension and medical aid schemes. Married and single accommodation is available.

Applications should be addressed to the Lancashire Steel Corporation Limited, Warrington, Lancashire, for the attention of Mr. P. E. Holloway, to reach him not later than 1st February, 1960.

E8384

TENDERS

YORKSHIRE OUSE RIVER BOARD

PASTURE ROAD BRIDGE, MEXBOROUGH

The Board invite TENDERS from well-experienced Contractors for the CONSTRUCTION of a FOUR-SPAN STEEL GIRDER ROAD BRIDGE with concrete piers and abutments to carry the Mexborough/Marr County Road over a diversion of the River Dearne at Pasture Road, Mexborough, Yorkshire.

Conditions of contract, specification, bill of quantities and drawings, may be obtained from the undersigned on deposit of Two Guineas, which will be returned on receipt of a bona fide Tender and the return of all the documents and drawings supplied. Cheques are to be made payable to the Yorkshire Ouse River Board.

Tenders, enclosed in the envelope provided, must be returned to the undersigned not later than 10 a.m. on Monday, 1st February, 1960.

The Board do not bind themselves to accept the lowest or any Tender.

E. W. WELLS, B.Sc., M.I.C.E.,
Engineer to the Board.

E8342

INDIA SUPPLY MISSION

The Office of India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, 8, D.C., United States of America, invites TENDERS for the following.

TENDER ENQUIRY No. SE. 130

For the SUPPLY of TWO 30,000kW STEAM TURBO-ALTERNATORS complete with Condensers, feed water heaters, &c., required by the Madya Pradesh State Electricity Board, for Amar Kantak Thermal Power Station.

Specifications, &c., relative to the above specification, can be obtained from the Co-ordination Branch, India Store Department, Bromyard Avenue, Acton, W.3, at a cost of £1 15s. 8d. per Tender, and is not refundable. Tenders are to be returned direct to India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, 8, D.C., United States of America, so as to reach them by 17th February, 1960.

Specimen copy of the above enquiry can be seen at India Store Department, Engineering Branch, Bromyard Avenue, Acton, W.3, under the following reference : S.3734/59/NSC/ENG.2. E8340

CITY OF LIVERPOOL

TENDERS invited for the SUPPLY and INSTALLATION OF PLANT and MACHINERY in the new Public Laundry and Baths, St. Domingo Road, Liverpool, 5.

Details from Baths Manager and Engineer, 62, Fontenoy Street, Liverpool, 3. Tenders returnable by 18th January, 1960.

THOMAS ALKER,
Town Clerk.

(J.5971) E8378

TENDERS

INDIA SUPPLY MISSION

The Office of the India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, 8, D.C., United States of America, invites TENDERS for the following :

TENDER ENQUIRY No. SE 131

For the SUPPLY of REVERSE CIRCULATION DRILLING RIG (Light Type) required by Neyveli Lignite Corporation (Private), Ltd.

Specifications, &c., relative to the above specification, can be obtained from the Co-ordination Branch, India Store Department, Bromyard Avenue, Acton, W.3, at a cost of 14s. 3d. per Tender, and is not refundable. Tenders are to be returned direct to India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington, 8, D.C., United States of America, so as to reach them by 16th February, 1960.

Specimen copy of the above enquiry can be seen at India Store Department, Engineering Branch, Bromyard Avenue, Acton, W.3, under the following reference : S.3888/59/NSC/ENG.2. E8357

EDUCATIONAL

CHESHIRE EDUCATION COMMITTEE

CHESHIRE COUNTY TRAINING COLLEGE, ALSAGER

ONE-YEAR COURSE OF TEACHER TRAINING FOR CRAFTSMEN

At the request of the Ministry of Education, the Cheshire Local Education Authority will provide, at the above-named College, from September, 1960, a new one-year course designed to give skilled Craftsmen teacher training to enable them to take up posts as teachers of Handicrafts in Secondary Schools.

Applications are therefore invited for admission to this course from men who already possess appropriate qualifications, such as a Full Technological Certificate of the City and Guilds of London Institute, or an Ordinary National Certificate or Higher National Diploma, and who wish to be trained as teachers.

The particular academic requirements of individual students and the application of their craft skills to the needs of schools will be specially studied. The year of training will include periods of teaching in schools.

The basic salary scale for qualified assistant teachers is £520 per annum, rising by annual increments of £27 10s. and one final increment of £40, to a maximum of £1000. Additional increments are given for approved qualifications and training. Account may also be taken of approved industrial experience acquired over the age of 21, up to a maximum of twelve increments.

Anyone needing further advice about the course, the qualifications required, the grants available to students while attending the course, and the teaching prospects available at the end of the course, should communicate with the Principal, the Cheshire County Training College, Alsager, Stoke-on-Trent. Applications for admission to the course should also be made to the Principal. Early application is advised.

JOHN G. KELLETT,
Director of Education.

County Hall,
Chester. E8398 E

A.M.I.MECH.E., B.Sc., City and Guilds, etc Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent successes. 148-page prospectus free, on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES NOT ORIGINALS OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

A DESIGN ENGINEER is required by Imperial Smelting Processes, Ltd., to assist in the design of blast furnaces and ancillary plant for the simultaneous extraction of zinc and lead. The work calls for a person of high academic ability who is capable of bringing original ideas to bear on the problems presented. A first-class Honours or higher Degree in Mechanical Engineering will therefore be sought, together with sound design experience—preferably in the heavier type of engineering. Applicants must be under the age of 36 and prepared to travel abroad if required. A knowledge of German would be an advantage. Conditions of service are good and a commencing salary in the range £1500–£1750 is envisaged.—Write for application form to Personnel Manager, Imperial Smelting Corporation, Ltd., Avonmouth, Bristol, quoting reference E/TE.

E8390 A

APPLICATIONS ARE INVITED from ambitious and resourceful men to fill the position of TECHNICAL ASSISTANT to the Sales Manager of Electric Lamp Machinery Manufacturers near London. A permanent, progressive and interesting job is offered to the right person, who must possess a sound engineering and commercial background in the trade.—Applications, with full particulars of education, experience and salary required to BOX No. E171, " The Engineer." A

CIVIL ENGINEERING ASSISTANT required for design and drawing of reinforced concrete industrial structures and foundations.—Apply to the Chief Engineer, The A.P.C.M., Ltd., Portland House, Tothill Street, London, S.W.1. E8374 A

DESIGN ENGINEER required for proposal work on Water-Tube Boiler Plant. Several years' experience on design work in this field is essential and minimum qualifications are an engineering degree and/or A.M.I.Mech.E. The work is interesting and varied and covers a wide field of heat-transfer application. Salary according to experience. Contributory Pension Fund. Staff dining room. State (in writing), age and experience.—Staff Manager, Foster Wheeler, Ltd., 3, Ixworth Place, London, S.W.3. E8349 A

BOOKS and PUBLICATIONS

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By D. SHIREBY, A.R.I.C. This book provides an elementary account of chemical thermodynamics suitable for students in the earlier years of technical college and university courses and in the sixth forms of grammar schools. The mathematics involved are fairly easy and the text includes many worked examples. 20/- net.

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SITUATIONS VACANT

DESIGNER DRAUGHTSMAN required, preferably with H.N.C. in Mechanical Engineering. Non-Contributory Pension Scheme available.—Applications to Metalectric Furnaces, Ltd., Cornwall Road, Smethwick, 40, Staffs. E2662 A

DESIGN DRAUGHTSMEN are required by Company engaged in the Manufacture of Hydraulic Loading Shovels. Applicants must be able to work with the minimum of supervision on a wide range of subjects which include Transmission, Hydraulics, Chassis Design, Welded and Cast Structures. These positions demand originality and versatility and applications will only be considered from Designers who are prepared to work at a high tempo. H.N.C. minimum qualification.

Apply in writing to Chief Designer, stating experience, qualifications, age, salary, &c.

F. E. WEATHERILL LIMITED, Tewin Road, Welwyn Garden City. Telephone : Welwyn Garden 4221.

E8395 A

DEVELOPMENT ENGINEER

A Qualified MECHANICAL ENGINEER, aged 25–35, is required to take charge of the Development Section of the Engineering Department in London of a major international food manufacturing Company, and to be responsible for carrying out the Company's engineering research progress.

A thorough engineering background is essential with academic training up to Degree or H.N.C. level. Practical experience in design, operation or development in some of the following processes is required : food canning, wrapping and packaging—general fold machinery—pharmaceutical and fine chemicals—and acid plant.

Initiative, ingenuity in design, and the ability to pursue a specified project from conception to final proofing are a fundamental requirement. This is a permanent appointment offering good prospects to a man with the ability and will to progress. Conditions of employment are excellent,and include a superannuation scheme. The salary will be assessed according to age, qualifications, and a record of proved ability.

Please write with full details of age, qualifications and experience.—BOX No. E8353, "The Engineer."

A

DRAUGHTSMAN

Applications are invited for the above post, which is located in Birmingham.

The work is interesting and varied and is mainly in connection with the design of industrial heating equipment. A knowledge of combustion technique and the use of rrefractories would, therefore, be an advantage.

Candidates should possess the Ordinary National Certificate in Mechanical Engineering as a minimum qualification.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £733–£853 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15.

E174 A

DRAUGHTSMAN (Proposal) for interesting work on complete Water-Tube Boiler installations. Applicants should have some previous experience on Water-Tube Boiler construction and layout. Salary according to experience but not less than £15 per week. Contributory Pension Fund. Staff dining room. State (in writing), age and experience. —Staff Manager, Foster Wheeler Limited, 3, Ixworth Place, London, S.W.3. E8348 A

DRAUGHTSMAN REQUIRED—must be well experienced in Belt Conveying and Material Handling practice and must be capable of both design and detail work. Salary of £1100 paid to right applicant.—Write in first instance stating age, details of experience and qualifications, to Maxim Conveyors (England) Limited, Crabtree Manorway, Belvedere, Kent. E2664 A

DRAUGHTSMEN required by Consulting Engineers for varied work in Reinforced Concrete and Structural Steelwork. Good starting salaries and annual increments based on ability. Five-day week. Pension scheme.—Sir William Halcrow and Partners, Alliance House, Caxton Street, S.W.1. E8396 A

DRAUGHTSMEN.—Vacancies have occurred for young men—versatile—as ENGINEERING DRAUGHTSMEN in a Plastics Manufacturing Company. General experience required—Higher National Certificate desirable. A.E.S.D. rates and above. Good working conditions, contributory pension scheme. The factory is situated in pleasant country between Ipswich and Colchester, and within easy reach of the Essex and Suffolk coasts. Transport facilities are available from Ipswich, Colchester, Harwich and Clacton areas.—Applications should be made in writing to the Personnel Manager at BX Plastics, Ltd., Brantham Works, Nr. Manningtree, Essex, stating age, qualifications and experience and career to date. E8345 A

DRAUGHTSMEN/DESIGNERS required for London Office of Unilever Limited for layout and design details of mechanical plant in overseas factories. Candidates should be workshop trained, with at least O.N.C., and have experience in general engineering.—Send particulars of age, training and experience to : Head Office Staff Department (WF 52), Unilever Ltd., Unilever House, E.C.4. E8371 A

ENGINEER.—A large manufacturing company, with Head Offices in Manchester, has a vacancy for a MECHANICAL or ELECTRICAL ENGINEER, to be engaged on the installation and maintenance of plant and machinery. Applications are invited from qualified engineers between 30/40 years of age with industrial experience, who are prepared to travel. The initial salary will be in the region of £1250. Apply, giving details of career and present salary, to the Chief Personnel Manager.—BOX No. E8394, "The Engineer." A

ELECTRICAL ENGINEER required, to be responsible for the design and installation of electrical equipment in major development schemes. The work is concerned with plants for the handling and processing of roadstone materials. Candidates with experience in the quarrying or allied industries are preferred. Written applications, containing full details, should be made to the Development Manager, Tarmac Roadstone Limited, Ettingshall, Wolverhampton. E8388 A

ENGINEERING DRAUGHTSMAN

The Nestle Company Limited is seeking a man who wishes to assume an important post with a view to progressing to a position of authority. Those who are aged between 24 and 28, in possession of the H.N.C. and have previous experience of process or chemical layout, are invited to apply. The preparation of installation and detail drawing, together with occasional visits to our many factories within the United Kingdom, form part of the duties involved. An excellent salary and Pension Scheme awaits the right man, together with luncheon vouchers whilst at our City Head Office. Write now, giving fullest details of previous experience, age and present salary, to the Personnel Manager, The Nestle Company Ltd., St. Georges House, Wood Street, E.C.2. E8360 A

ENGINEERS, Civil and Mechanical—temporary—required by Iron Ore Mining Company for one tour of approximately 18 months' duty in BRITISH WEST AFRICA. Civil Engineer to supervise foundation and steelwork contracts, and Mechanical Engineer to supervise installation of plant and machinery, including electrics, in an ore concentrating plant. Engineers with previous experience of contract supervision essential. Salary £1900 per annum, plus bonus plus for married man, marriage allowance at the rate of £10 per month and children's allowance at the rate of £5 per month for each child under 18. Dependant's income scheme and free life assurance. Return passage paid. Initial kit allowance. Free furnished accommodation and medical attention.—Write, giving full details of experience, stating age, married or single, to SIERRA LEONE DEVELOPMENT CO. LTD., Dept. M.P.8., City Gate House, Finsbury Square, London, E.C.2. E6365 A

ENGINEER SURVEYOR required in South of England by leading Insurance Company for inspection of Boiler and Pressure Plant. Must hold 1st Class M.O.T. Certificate with Steam Endorsement or equivalent. Commencing salary £800 rising to £1100. Car driver—not over 38 years.—Write Box E792, LPE, Romano House, 399-401, Strand, London, W.C.2. E8369 A

INSTRUMENT MAKER, ELECTRICAL and MECHANICAL, required. Applicants should be fully conversant with the maintenance of all modern industrial instruments and capable of making and testing such apparatus. Please write, giving full particulars of experience and age.—BOX No. E8386, "The Engineer." A

MECHANICAL ENGINEER

required, to play a senior part in mechanical design and contract control on chemical plant projects, with experience in this field, either with a plant manufacturer or user. The successful applicant will be in his early 30's and will have advanced rapidly in salary and status during the last few years.

Send full details of career, including salary history, to the Staff Officer,

WHESSOE LIMITED,
Darlington.

E8373 A

MECHANICAL ENGINEER with senior status required for research and development work in Manchester. Honours Degree, good knowledge of thermodynamics metallurgy and experience with design calculations of various kinds of thermal plant essential.—Apply, Kennedy and Donkin, 12, Caxton Street, London, S.W.1, or 64, Royal Exchange Manchester. E8309 A

PILKINGTON BROTHERS LIMITED, St. Helens, have two vacancies for DEVELOPMENT DRAUGHTSMAN DESIGNERS to work with the team which is developing Float Glass.

The work will be varied and interesting and, due to the nature of the process, will afford scope for initiative and responsibility.

Minimum qualifications H.N.C. Mechanical.

Applications should be addressed to Group Staff Department, Head Office, Pilkington Brothers Limited, St. Helens, Lancashire.

E8364 A

PILKINGTON BROTHERS, LIMITED, Cowley Hill Works, have vacancies in their Drawing Office for MECHANICAL DRAUGHTSMEN. Applicants should have had experience in Plant Layout or Machine Design and should have a Higher National Certificate in Mechanical Engineering, or be working for it. Applications should be addressed to the Works Personnel Officer, Pilkington Brothers, Limited, Cowley Hill Works, St. Helens. E8354 A

SENIOR DESIGN DRAUGHTSMEN, familiar with small mechanisms, etc., required by progressive and expanding Company situated approximately 20 minutes from Waterloo. The positions offered are permanent and provide excellent prospects for versatile men who seek interesting work in a new field.—BOX No. E169, "The Engineer." A

TECHNICAL ASSISTANT—ELECTRICAL—aged 24/30, required by a large and expanding company in S.E. Essex Thameside area. Candidates should have completed a recognised training period in industry, have a good knowledge of A.C. and D.C. circuits and educated to H.N.C. (Elect.) or equivalent standard. Good prospects and remuneration. Please send full details in confidence.—BOX No. E8377, "The Engineer." A

Classified Advts. continued on page 90

SITUATIONS VACANT

SENIOR PROJECT DRAUGHTSMAN required for Mechanical Handling Plants. Applicants must be able to lay out schemes. Experience in Estimating an advantage but not essential. Good prospects.—W. W. Brown & Partners, Ltd., 72, Newman Street, London, W.1. E2660 A

TECHNICAL ASSISTANT (ELECTRICAL) required to assist in the preparation of servicing manuals and to carry out and report on special tests on development work on electrical equipment in the Printing Industry. A sound theoretical background and an ability to express technical information in good English is essential. Some knowledge of basic electronic circuits would be an additional advantage, and candidates should be studying for, or have obtained H.N.C. in Electrical Engineering.

Please apply in writing stating age, qualifications and full details of past experience to :

The Personnel Manager,
Messrs. Witton-James, Ltd.,
The Hyde Electrical Works,
Hendon, N.W.9. E8336 A

THE VILLIERS ENGINEERING COMPANY LIMITED, MARSTON ROAD, WOLVERHAMPTON

Applications are invited from suitably qualified Engineers for positions of DESIGN DRAUGHTSMEN in connection with the development of high-speed Internal Combustion Engines.

Appointments will carry salaries commensurate with the responsibility.

All applications in writing, to the Personnel Manager, giving full details of qualifications and experience, also quoting present salary.

E8338 A

VACANCIES FOR FIVE RESIDENT ENGINEERS

Applications are invited from Civil Engineers to supervise pipe-laying contracts in Lanarkshire. The work would embrace setting-out, supervision of excavations in varying formations, including rock, the laying in trenches of large diameter steel pipes with "Viking Johnson" couplings and other ancillary works, and the checking of contractors' interim certificates. It is anticipated that the appointments would be for about 18 months.

Applicants must be Corporate Members of the Institution of Civil Engineers, preferably with experience in similar works.

Salaries would be in the range £1200–£1450 per annum, depending upon age and experience.

Written applications, with age and full particulars, should be sent to Messrs. Binnie, Deacon and Gourley, Consulting Civil Engineers, Artillery House, Artillery Row, Westminster, London, S.W.1, not later than 11th January, 1960.

E8296 A

VACANCIES FOR TEN INSPECTORS OF WORKS

Applications are invited from Inspectors of Works to supervise pipe-laying contracts in Lanarkshire.

The work would embrace supervision of excavations in varying formations, including rock, the laying in trenches of large diameter steel pipes with "VIKING JOHNSON" couplings, other ancillary works, the measurement of completed works and checking of contractors' interim certificates.

It is anticipated that the appointments would be for about 18 months' work. Salaries would be in the range £750–£850, depending upon age and experience.

Written applications, with age and full particulars, should be sent to Messrs. Binnie, Deacon and Gourley, Consulting Civil Engineers, Artillery House, Artillery Row, Westminster, London, S.W.1, not later than 11th January, 1960.

E8295 A

VACANCIES FOR TWO ENGINEERING CLERKS

Applications are invited for these two vacancies on the staff of the Chief Resident Engineer of several large pipelaying contracts in Lanarkshire.

The duties of the successful applicants would include the maintenance of filing systems, checking interim and final certificates of Contractors, copy typing and general office routine.

Previous experience of engineering works office routine would be advantageous.

It is anticipated that the appointments would be for about 18 months.

Salaries would be £600 per annum.

Written applications, with age and full particulars, should be addressed to the Chief Resident Engineer, Daer Water Scheme, c/o the Clerk to the Daer Water Board, P.O. Box No. I, Lanarkshire House, 191, Ingram Street, Glasgow, C.1, not later than 20th January, 1960. Interviews by appointment will be held in Glasgow during the first week in February.

E8287 A

THE PRODUCTION MANAGER of a modern Light Engineering Factory in Shannon, Ireland, immediately requires A FIRST-CLASS DESIGNER DRAUGHTSMAN. The applicant must be up to the H.N.C. standard and have had workshop training, together with experience in light engineering design. Write in the first instance to the Production Manager, giving full details of career, salary required, &c.—BOX No. E8393, "The Engineer." A

VACANCIES FOR TWO ASSISTANT RESIDENT ENGINEERS

Applications are invited from Civil Engineers to supervise pipe-laying contracts in Lanarkshire. The work would embrace setting-out, supervision of excavations in varying formations, including rock, the laying in trenches of large diameter steel pipes with "Viking Johnson" couplings, and other ancillary works, and the checking of contractors' interim certificates. It is anticipated that the appointments would be for about 18 months.

Applicants must have passed Parts (a) and (b) of the Examination of the Institution of Civil Engineers and preferably have had experience in similar works.

Salaries would be in the range £950–£1050 per annum, depending upon age and experience.

Written applications, with age and full particulars, should be sent to Messrs. Binnie, Deacon and Gourley, Consulting Civil Engineers, Artillery House, Artillery Row, Westminster, London, S.W.1, not later than 11th January, 1960.

E8294 A

WANTED, FIRST-CLASS SENIOR DESIGN DRAUGHTSMAN for firm of General Engineers in Bristol. Good knowledge of general engineering, with particular reference to pressure vessels and stainless steel fabrication. This will be a well-paid position for the top-class man.—BOX No. E164, "The Engineer." A

WORK ENGINEER holding qualification in Electrical and/or Mechanical Engineering. Responsibilities : maintenance building and engineering manufacturing plant ; also Safety Officer. Salary : £1200 per annum. Apply, stating qualifications and details of past experience.—BOX No. E2667, "The Engineer." A

WORKS ENGINEER

Applications are invited for the position of Works Engineer for an expanding medium-sized manufacturing company in the East Midlands. The successful applicant will be responsible for the installation and mechanical and electrical maintenance of a wide variety of plant, some of which has electronic controls. Minimum requirements are professional qualifications in mechanical or electrical engineering and some years' experience in a similar position. Initial salary will be in the range of £1400 to £2000 per annum, according to qualifications and experience.—Please reply to Orr and Boss and Partners, Ltd., 57, Victoria Street, London, S.W.1, giving full details of age, experience and existing appointment. E8375 A

ENGLISH ELECTRIC, RUGBY

STEAM TURBINE DIVISION

Experienced **CONDENSER DRAUGHTSMEN** required by English Electric, Rugby, for their Steam Turbine Division. Applicants must have served a recognised apprenticeship, and have two or three years' Drawing-Office experience of condenser or feed heating plant, and should preferably have reached H.N.C. standard. The Condenser Department at Rugby is concerned with advanced and novel designs of condenser plant and good opportunities exist for experienced men. Housing assistance can be considered for married applicants selected for employment. Write, giving full details to Dept. C.P.S., Marconi House, 336-7, Strand, London, W.C.2, quoting reference E1199X.

E8387 A

The Harland Engineering Co. Ltd., Alloa, Scotland, is expanding its activities in the manufacture of Centrifugal Pumps, Electrical Rotating Machinery and Hydro Electric Plant and first class draughtsmen are required for senior appointments in the drawing-office for

CENTRIFUGAL PUMP LAYOUT
SENIOR DRAUGHTSMAN with experience of large single and multi-stage pumping plant.

WATER TURBINE LAYOUT
SENIOR DRAUGHTSMAN with experience of Francis, Impulse and Kaplan turbines.

ELECTRICAL ROTATING MACHINERY DESIGN
SENIOR DRAUGHTSMAN with experience in mechanical design of electric motors and generators.

Conditions of service in pleasant residential area and modern office, include 39½-hour week, contributory pension scheme, canteen facilities and extended holidays after 12 months.

Write, giving full particulars of age, qualifications, experience, &c., to the Chief Draughtsman, B.E.P. Works, Alloa, Scotland. E8391 A

LLOYD'S REGISTER OF SHIPPING

require

TWO ENGINEERS

initially for Research and Engineering Investigation, able to supervise laboratory tests and undertake stress calculations from strain gauge analyses. Applicants should possess a University Degree in Engineering, or equivalent qualifications, and have had some experience in Industry. These posts offer ample scope for advancement in the Society's service.

Commencing salary in the range of £1100–£1500 per annum, depending on qualifications and experience. Apply : Secretary, Lloyd's Register of Shipping, 71, Fenchurch Street, London, E.C.3.

E8399 A

PROJECT ENGINEER

Applications are invited from suitably qualified persons for appointment as Project Engineer in an expanding Division of an old-established Company in Yorkshire.

The work is concerned with controlled atmosphere generators and gas drying equipment, and the project engineer would be responsible for the design, installation and subsequent testing of new plant, and the work would involve some time spent on site.

Candidates should have a technical qualification in chemical engineering or fuel technology, preferably to degree standard.

Superannuation scheme and other benefits.

Salary by arrangement.

Please send brief details in confidence, quoting Ref. GHD, to BOX No. E8310, "The Engineer."

A

SKF

require

a

METHODS ENGINEER

E8358 A

SMITH KLINE & FRENCH LABORATORIES LIMITED

announce that a vacancy exists for a METHODS ENGINEER in their Production Division.

Applications for this new post are invited from men, aged 28-35, who possess A.M.I.Mech.E., B.Sc.(Eng.), Dip.Tech., or an equivalent qualification.

Responsibility will be carried for increasing the overall productivity of production operations within the Company in the fields of manufacturing, packaging and warehousing. Experience of the use and modification of high-speed packaging equipment and of Work Study techniques is essential, and the ability to establish first-rate working relationships at all levels is a necessary personal attribute.

Starting salary will be based on qualifications and experience and will be progressive on a merit basis. Company benefits include a non-contributory Pension and Life Assurance Scheme.

Under certain circumstances rented accommodation may be made available in the Welwyn Garden City area.

Letters of application giving fullest relevant details should be addressed to:—

THE PERSONNEL OFFICER
SMITH KLINE & FRENCH LABORATORIES LTD.
Hundells, Welwyn Garden City, Herts.

CHIEF PLANNING ENGINEER

required for

KENDALL & GENT, LIMITED

This leading firm of MACHINE TOOL MANUFACTURERS in the MANCHESTER area offers high salary and status to a Planning Engineer possessing a thorough knowledge of production planning and control as applied to the field of medium and heavy duty machine tools. Must be familiar with modern methods of analysis, graphs and other precise controlling and planning records.

A first-class opportunity for a man who knows he has the above qualifications and can demonstrate the fact to expert production men. Works staff of high calibre are eligible for all posts (at home and overseas) in the Sykes group of which Kendall and Gent, Limited, forms part.

Apply: The Secretary, Manor Works, Staines, Middlesex.

E8335 A

PROFESSIONAL ENGINEER

is required at the

ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET, to be responsible for the operation of a continuous programme of exponential experiments, the handling and safe storage of associated fissile and radioactive materials and the specification of auxiliary equipment required by scientific staff.

Salary (according to age, qualifications and experience) in the range £860 p.a. (at age 25) £1825 p.a.

Housing and superannuation schemes.

Send Postcard for application form and details to Personnel Branch (W 196/25), U.K.A.E.A., A.E.E., Winfrith, Dorchester, Dorset, not later than 15th January, 1960.

E8351 A

SITUATIONS VACANT

A CONTRACTS ENGINEER

for PUMP DEPARTMENT

is required by

W. H. ALLEN SONS & CO., LTD.,
QUEENS ENGINEERING WORKS,
BEDFORD

The appointment is a responsible one, involving the handling of projects, tenders and contracts for complete pumping schemes. Applicants should have served an apprenticeship and reached at least Higher National Certificate standard, with experience in either drawing office, commercial department, plant operation or manufacture.

Good staff Pension Scheme ; assistance towards removal expenses.

Apply, stating age, experience, present salary, &c., to The Personnel Manager (quoting Ref. No. CA.202).

E8352 A

SITUATIONS VACANT

TECHNICAL AUTHORS

fully experienced in all aspects of compiling industrial and services manuals required for West London Company manufacturing wide range of Electronic equipment. Techniques include pulse, A.M., F.M., and transistor application.

TECHNICAL EDITOR

also required for the preparation of technical reports from notes supplied by laboratory engineers. Electronic background essential. The reports, which include illustrations, are for submission to customers and need to be of appropriate standard.

THESE ARE ALL SENIOR POSITIONS CARRYING COMMENSURATE SALARIES

Free Life Assurance and Contributory Pensions Scheme.

Applications (in strictest confidence) to BOX No. E8337, " The Engineer."

A

SITUATIONS VACANT

SENIOR MECHANICAL ENGINEER

Minimum B.Sc. in Mechanical Engineering with 10 years' experience in the design and selection of centrifugal and reciprocating compressors and prime movers, refrigeration systems, blowers and ancillaries as applied to compression equipment.

He will be required to originate specifications for all mechanical and ancillary equipment for cryogenic plants, review and recommend equipment from proposal stage, prepare operating instructions and to site inspect for commissioning and to develop prototype designs within the company and with manufacturers.

Apply Personnel Manager,
AIR PRODUCTS (GB), LTD.,
49-50, Poland Street, London, W.1.

E8332 A

SITUATIONS VACANT

STANDARDS ENGINEER

Graduate H.N.C. (Mech.) minimum, with 3 years' experience as a Standards Engineer in the Chemical and Process Plant Industry. To originate and prepare engineering standards for use in the Design Department and other engineering facilities of the Company on request and to develop these standards into a comprehensive manual on his own initiative. Must be able to develop fully design standards for all aspects of pressure vessel, piping and mechanical design for ferrous and non-ferrous applications. Experience of high pressure and high temperature systems is necessary together with an intimate knowledge of all valves and flange systems. Must possess leadership potential to develop a fully integrated Standards Group.

Write : Personnel Manager,
AIR PRODUCTS (GB), LTD.,
49-50, Poland Street, London, W.1.

E8334 A

ICI Experienced Graduate Engineers

are required by

the manufacturers of the widest range of plastics, raw materials and semi-finished products in the Commonwealth.

THE PLASTICS DIVISION OF IMPERIAL CHEMICAL INDUSTRIES LIMITED is now expanding its Engineering Department in order to keep pace with growing sales in home and overseas markets. Enquiries are invited from :

MECHANICAL AND CHEMICAL ENGINEERS

holding first or second class honours degrees with some years of industrial experience.

The Division is looking for men of energy, initiative and proved ability. Good starting salaries will be paid immediately, and prospects for the future are excellent. The individual projects upon which candidates will be engaged vary in character and involve all types of engineering, from light precision machine work to heavy process. They include all the planning, layout and procurement associated with the design and erection of large manufacturing units. Some of the work is experimental, directed towards manufacture in new fields.

Conditions of service are good, and pension and profit-sharing schemes are in operation. For married men, temporary lodging allowances are available and assistance is given towards house purchase and removal expenses.

Apply briefly to :

The Staff Manager,
IMPERIAL CHEMICAL INDUSTRIES LIMITED,
Plastics Division,
Black Fan Road, Welwyn Garden City, Herts.

E8350 A

CHIEF ENGINEER

An international consumer goods manufacturer, acknowledged leader in its branch of industry, wishes to make a high level appointment in engineering management.

The company has reached its present outstanding position in the United Kingdom through steady, continuous expansion, and it is planning for further development in which the co-ordination of many technologies must play a vital part.

Substantial advances have recently been made in the provision of additional production capacity and the installation of modern plant and equipment.

The Chief Engineer will be responsible to the Director of Engineering for all aspects of the Company's diverse engineering activities—mechanical, electrical, constructional and industrial.

The most important requirement is proved ability and experience in leading qualified men and co-ordinating the work of different specialised groups. Candidates must be able to show evidence of this, almost certainly in terms of a previous industrial management post. They must also be fully qualified in one or more engineering fields, and experienced in negotiating with consultants and public authorities. Finally, they should be at least 35 years of age, and earning more than £2,000 p.a.

The location of the appointment is London, and terms of employment will be appropriate to the high importance attached to it.

Please write fully.—BOX No. E2666, " The Engineer."

A

ICI draughtsmen

To meet an expanding programme of development,

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PLASTICS DIVISION

urgently need more Draughtsmen. In particular, men are required experienced in work associated with process plant, *e.g.* piping, heating and ventilating, drying, powder conveying and packing. Mechanical draughtsmen are also needed since the programme includes development work in novel processes which are essentially mechanical in nature. There are vacancies too for men with instrument and electrical design experience.

Good starting salaries will be paid and pension and profit sharing schemes are in operation. For married men temporary lodging allowances are available and assistance is given towards house purchase and removal expenses.

Apply briefly to the Staff Manager:

IMPERIAL CHEMICAL INDUSTRIES LIMITED
PLASTICS DIVISION
BLACK FAN ROAD, WELWYN GARDEN CITY, HERTS.

E8297 A

WEATHERLEY OILGEAR LIMITED

TO SERVE THE MORE ADVANCED FIELD OF HYDRAULICS

REQUIRED: SENIOR TECHNICAL SALES ENGINEERS

to operate as district representatives for London and South—Midlands—Northern England—Scotland. Applications are invited from those already residing centrally in these areas.

Age Group : 35 to 45 years of age.

An informative period will be foreseen but qualifications should include a good practical as well as technical knowledge and experience of the modern version of Hydraulic and Processing Applications for industry at large.

Also required are four layout engineers, either experienced in Hydraulic Application or with good technical qualifications for training.

Applicants are asked to forward fullest information, including education, training and experience (present Salary Status will help) and sufficient detail to facilitate early arrangements for interview in London.

Address to : Personnel Manager, HYDRAULIC DIVISION, Weatherley Oilgear Limited, Biggleswade, Beds.

E8189 A

Classified Advts, continued on page 92

SITUATIONS VACANT

NUCLEAR ENGINEERING

GRADUATE DESIGN ENGINEER

required for work on novel projects connected with nuclear steam-generating plant.

Preferred qualifications are a good engineering degree and some experience of the practical aspects of design and operation of high-pressure steam plant. Graduates straight from college would be considered. Maximum age of candidates is 30 years. Salary in the range, £900–£1200 per annum. Contributory Pension Scheme.

Applications should be made in writing, giving details of age, qualifications and experience, to

Staff Manager,
Foster Wheeler Limited,
3, Ixworth Place,
London, S.W.3.

E8376 A

SITE ENGINEERS

H.N.C. with at least ten years' experience in administration of large sites in the Oil Refinery or Chemical Industries. Experience to include use of surveying instruments, steelwork erection, installation of vessels and mechanical equipment, fabrication and erection of pipe work in mild steel, stainless steel and aluminium.—Write Box No. DA.1932, c/o Whites, 72, Fleet Street, London, E.C.4.

E8333 A

DEPUTY PRODUCTION ENGINEER

Required for a medium-sized company manufacturing specialised equipment for the vehicle and motor-car industries.

The Deputy Production Engineer will be responsible to the Production Engineer for the supervision of engineering staff covering process planning, work measurement, tool design and manufacture.

Candidates, who should have professional qualifications in production and mechanical engineering, must have extensive experience of modern machine tools, process planning, jig and tool design and work study in the light mass-production engineering field.

Experience in the design of special purpose transfer machines would be an advantage.

Age group : 30–45. Four-figure salary and non-contributory pension scheme. Please send full details of career in confidence, quoting reference LRM/PE.1, to CLAYTON DEWANDRE COMPANY, LIMITED, Titanic Works, Lincoln.

E8211 A

MATERIALS HANDLING ENGINEER

Required for a medium-sized company manufacturing specialised equipment for the vehicle and motor-car industries. The Materials Handling Engineer will be responsible to the Production Engineer for materials handling and factory layout.

Essential qualifications :—

(a) Experience in the preparation of materials handling schemes, including palletisation and conveyorisation in current use in the light mass-production engineering industry.
(b) Sound knowledge of modern factory layout for batch and flow production in machine, assembly and plating shops.
(c) Knowledge of machine design, planning, work study and foundry practice would be an advantage.

Candidates should have professional qualifications in production or mechanical engineering.

Age group : 30 to 45. Four-figure salary and non-contributory pension scheme. Please send full details of career in confidence quoting reference LRM/PE.2, to CLAYTON DEWANDRE COMPANY LIMITED, Titanic Works, Lincoln.

E8212 A

BUSINESS OPPORTUNITIES

REMPLOY SPONSORSHIP SCHEME.—Send for details which show an attractive proposition to manufacturers.—Write to the Managing Director, Remploy, Ltd., 25–28, Buckingham Gate, S.W.1, or telephone VICtoria 6621 (12 lines). E155 O

BUSINESSES and PREMISES

LAND FOR SALE

Industrial Site of 11 acres, 10 miles from Bournemouth. Offers wanted.—W. P. J. Miller, 280-282, Ashley Road, Parkstone, Poole. Tel. Parkstone 8 and 2878. E2663 L

PRECISION ENGINEERING BUSINESS for Sale. Turnover £75,000 per annum. Directors retiring.—BOX No. E172, "The Engineer." L

FOR HIRE

LATTICE STEEL ERECTION MASTS (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1. E103 K

MOBILE LIFTING SERVICES.—Lump sum or Hire Rate Quoted for any Lifting Work by Lorry-Mounted or Crawler Cranes, any size, any area.—TARSLAG, LTD., Rotherham 3235. E168 K

MISCELLANEOUS

TIME RECORDERS. Sales, Rentals, Service, Telephone Hop 2239.—Time Recorder Supply and Maintenance Co., Ltd., 157–159, Borough High Street, London, S.E.1. E110 I

MACHINERY Etc. WANTED

WANTED.—Crane on own chassis or lorry-mounted. All types up to 8 ton considered.—BOX No. E8156, "The Engineer." F

WE ARE BUYERS of complete line machinery mechanisation crankshafts for three, four or six cylinders, maximum length between points 820mm, half run 65mm. Address offers to BOX No. 888, Alas, Alcala, 32, Madrid, Spain. E8381 F

WANTED.—10-ton Second-hand DIESEL CRANE on own chassis or lorry mounted. Would prefer Jones or Coles Crane. Crane must be in first-class condition. Offers.—BOX No. E2668, "The Engineer." F

FOR SALE

SERVICE EDWARDS VALUE!

NEW BESCO 8ft. 4in. by ⅜in. Type HK, All Steel Undercrank Open-Ended Production Power Guillotine of all-steel construction, arranged motor drive for 400/440/3/50, length of blades 110¼in., capacity ⅜in., gap in side frames 3½in., strokes per minute 54.

CRAIG & DONALD Model 400/10, All Steel Motorised Double Geared Press Brake of steel plate construction, arranged motor drive for 440/3/50, pressure exerted 400 tons, former capacity 10ft. by ¼in., depth of gap 12in., width between side frames 82in., stroke approximately 4in., weight approximately 29 tons.

BESCO No. 21 size Inclinable Power Press, treadle-operated non-repeat clutch, ram fitted with knockout, fitted with detachable tie bars, standard stroke 3in., centre to back 9½in., bed 27in. by 18in., hole in bed 11½in. by 12in., can be supplied for belt drive or self-contained motor drive.

ROBERTSON Motorised Geared Section Rolling Machine, at present fitted with rollers for forming 2¼in. by 2¼in. angles sections, diameter of roll shafts 2¼in., width between bearings 16¼in., working centres adjustable up to 7¼in., 14 rollers arranged in 7 pairs, arranged motor drive for 400/440/3/50.

NEW STOELTING Pyramid Type Plate Bending Roller, Motorised 400/440/3/50, capacity 10ft. wide by ¼in. mild steel, diameter of rollers, top, 9¼in.; bottom, 7¾in., drop end bearing for removal of completed cylinders, support rollers to bottom rolls, reduction gearbox drive to bottom rolls with multi-disc slipping clutches, motorised adjustment to top roller.

RUSHWORTH Double Geared Open Ended Power Guillotine, overcrank type, fitted with automatic sheet hold-down and adjustable front, back and side gauges, arranged motor drive for 380/440/3/50, capacity mild steel 4ft. by ¼in., gap in open ends 6¼in.

Photographs of the above are available.

Very favourable Hire Purchase terms can be obtained.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.,
359–361, EUSTON ROAD,
LONDON, N.W.1.
Telephone : EUSton 4681–3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone : Central 7606–8.

E207 G

FOR SALE

SOAG

LATE TYPE
HEAVY DUTY
POWER PRESSES
IN STOCK

WILKINS & MITCHELL 200-ton Double-Sided Single Crank Cupping and Drawing Press, type CDP.3, all steel double gear drive, capacity 200 tons, length of stroke 16in., adjustment of stroke 3in., size of platens 32in. by 22in., h.p. motor 45.

BLISS No. 24 Knuckle Joint Press, cap. 400 tons, stroke 2½in., shut height 25/24½in., area of bed 20in. by 20in., h.p. motor 25.

HASENCLEVER Heavy Duty Double-Sided Knuckle Joint Indenting Press, type KHP 1500/5, capacity 1500/2000 tons, stroke per minute 32, slide adjustment 2⅜in., table area 34in. by 44in., h.p. motor 30.

WEINGARTEN Heavy Duty Double Column Upright Rack and Pinion Deep Drawing Press, type ZRSL, with variable control feed, maxmum pressure 100 tons, maximum stroke 83in., table area 34½in. by 39½in., with a.c./d.c. Gen. Set drive and complete control gear.

CHAMBERSBURG-GECOSTAMP 96in. by 48in. air operated Impact Press, H-section side frames, 20in. cylinder bore, working on 100 lb. air pressure, maximum distance anvil to ram 48in., very little used.

SOAG MACHINE TOOLS, LTD.,
JUXON STREET,
LAMBETH, LONDON, S.E.11.
'Phone : RELiance 7201.
'Grams : "Sotoolslag," London, S.E.11.

E8370 G

FOR DISPOSAL

One "Mirrlees" HF7 DIESEL GENERATOR, continuous rating 475kW at 375 r.p.m., complete with all a.c. driven ancillaries including "Heenan & Froude" water cooler and fuel header tank.

One "Brush" 475kW, 250 volt Compound Wound d.c. GENERATOR direct coupled to the above engine, fitted with local and remote control equipment and switchgear (panel mounted), in conjunction with the above diesel, one WASTE HEAT BOILER (Clarkson), rated at 850 lbs/hr., 40 p.s.i. working pressure complete with feed pump and auxiliary equipment.

Two WASTE HEAT BOILERS (Clarkson) rated at 850 lbs/hr. at 40 p.s.i. w.p., together with "Weir" feed pumps and thermofeed, &c., suitable for use as waste heat equipment on diesel engine exhausts.

Applications to BOX No. E8372, "The Engineer." G

"STOELTING" MODEL E4-1 PLATE BENDING ROLLER for sale. Capacity 39in. long by ¼in. thick. Pyramid type rollers, top roller 4⅜in. diameter. Bottom rollers 3⅜in. diameter. Complete cylinders can be removed. Arranged motor drive 400/440/3/50.—F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E8361 G

HYDRAULIC PRESSES
HYDRAULIC PUMPS

Hydraulic Accumulators, Valves, Fittings, New and Second-hand. Complete installations. All kinds of Hydraulic Equipment in Stock.

THOMPSON AND SON (MILLWALL), LTD., Cuba Street, Millwall, London, E.14. East 1844/5. E111 G

FOR SALE

"SEDGWICK" MOTORISED PRESS BRAKE for sale. Capacity 6ft. by ⅛in. mild steel. Width between side frames 41in. Depth of gap 15in. Die space stroke down adjustment up, 27½in. Steel plate side frames and bed. Motor drive for 440/3/50. Weight about 6 tons.—F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E8363 G

FRED WATKINS
(ENGINEERING) LTD.

Fielding 500-ton Vertical Downstroke Hydraulic Press, 42in. by 36in. platens, with pumps and motors.
Fielding 200-ton ditto, 3ft. stroke, with pumps and motors (5 available).
Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.
Two 73ft. 4in. by 4ft. Brick Lined Kilns or Dryers, with Crofts reduction gears and motors.
Two 26ft. by 4ft. Rotary Cooler or Dryers, with reduction gear and motor.

FRED WATKINS (ENGINEERING), LTD., COLEFORD, GLOS. E151 G

FOR SALE
BROWN & SHARPE NO. 2 STANDARD VERTICAL MILLING MACHINE

Table 54½in. by 14in. Power and rapid traverses, speeds 30–1200 r.p.m.

F. J. EDWARDS, LTD.
359–361, EUSTON ROAD,
LONDON, N.W.1.
EUSton 4681 and 3771.

E8343 G

BUNKER CLAMSHELL GATES
LEVER OR AIR OPERATED
ALL STEEL CONSTRUCTION

MAXIM CONVEYORS (ENGLAND) LTD., BELVEDERE, KENT
Ring ERITH 4223
E170 G

THOS. W. WARD LTD
ALBION WORKS, SHEFFIELD

Where Top Standards are required—

CROSS British made components are consistently being specified for use in the products of the future. Where top standards are required CROSS components are essential, they are manufactured using a specialised hardening and tempering process, and are extremely accurate.

WIRE THREAD INSERTS
SPRING WASHERS
CIRCLIPS and RETAINING RINGS
JET ENGINE LABYRINTHS

CROSS MANUFACTURING CO. (1938) LTD.
COMBE DOWN · BATH · SOMERSET · Tel: Combe Down 2355/8 · Grams : Circle, Bath.

Enter No. 921 on reply card

FOR SALE

FRED WATKINS (ENGINEERING) LTD.

STEAM BOILERS.—Cochrane Vertical (New), 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia., 100/150 lb. w.p.; reconditioned 8ft. 6in. down to 3ft. dia.; Economic 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p. 300 reconditioned Vertical Crosstube, all sizes.
AIR COMPRESSORS.—Two Bellias & Morcom 2500 c.f.m., 100 p.s.i., 550 h.p. motors; also Broomwade 500, 400, 300, 200 and 130 c.f.m., all motorised; and several others of various makes and capacities.
200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb. pressure.
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		Main Location	*Auctioneers*
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January 15	Miscellaneous stores, including :—	Returned Stores Group, Reed Hall, Colchester, Essex.	FENN, WRIGHT & CO. (Dept. L), 146, High Street, Colchester, Essex. (Tel.: 3171.)
	Tools, Reyrolle welding plants, 600-gallon fuel tanks, platform weighing machines, electric cable, fire-fighting equipment, cooking equipment, furniture, carpets, blankets, khaki drill and other clothing, canvas tents and covers, scrap metal, etc.		
February 2	Miscellaneous stores.	M.O.A. Storage Depot, Ruddington, Notts.	WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)
February 10	Miscellaneous stores.	Technical Stores Depot, Old Dalby, Leics.	SHOULER & SON (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 3081.)

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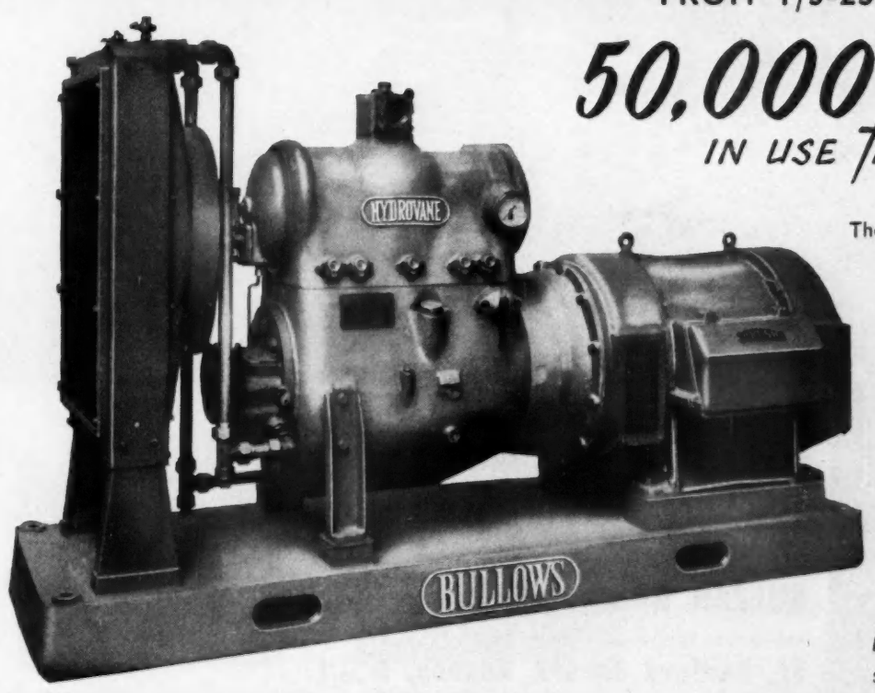

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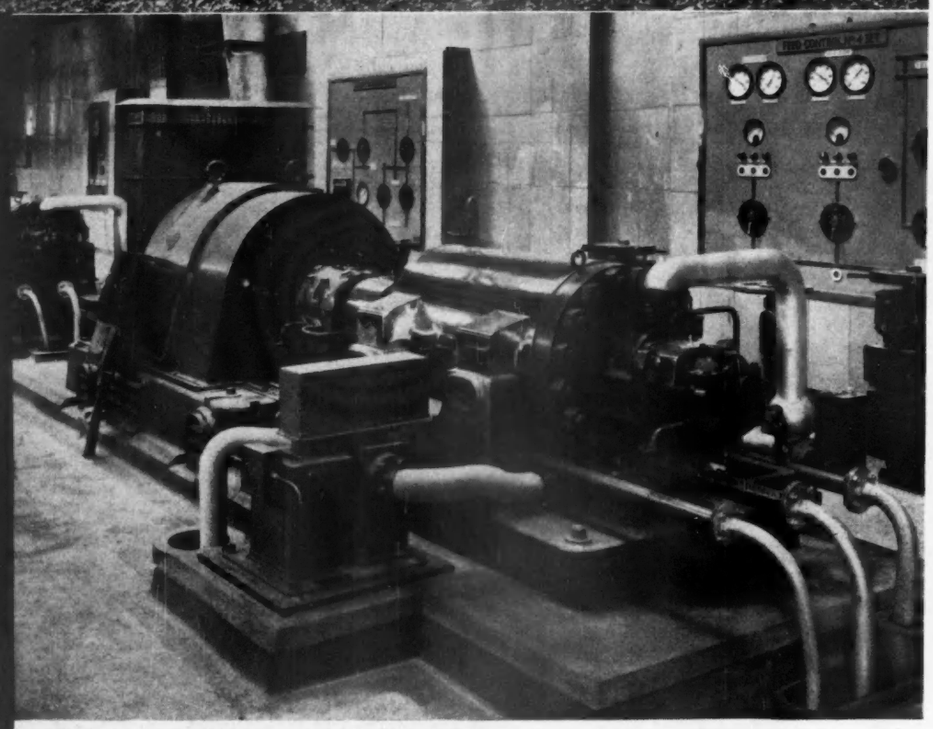

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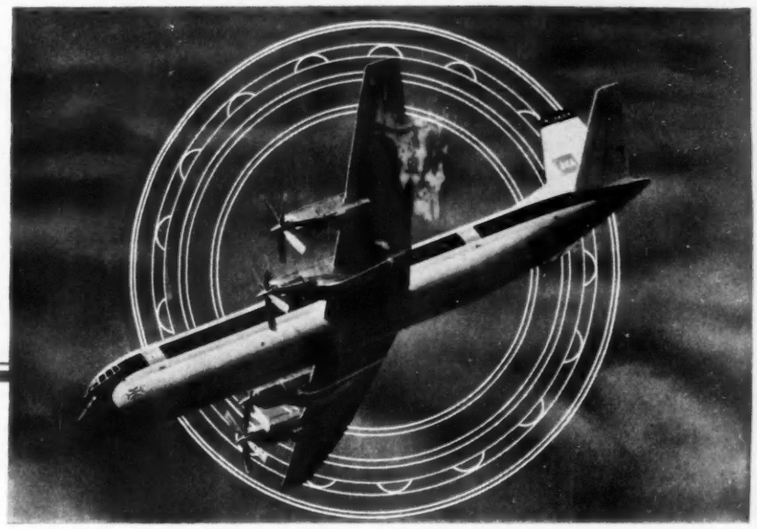

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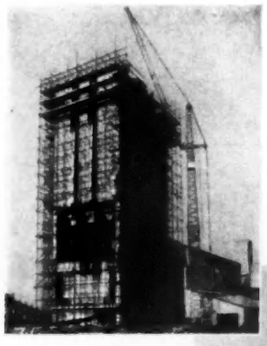

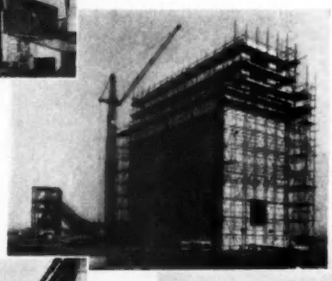

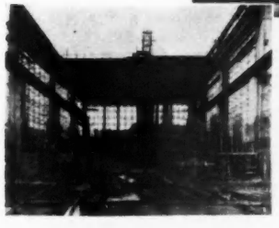

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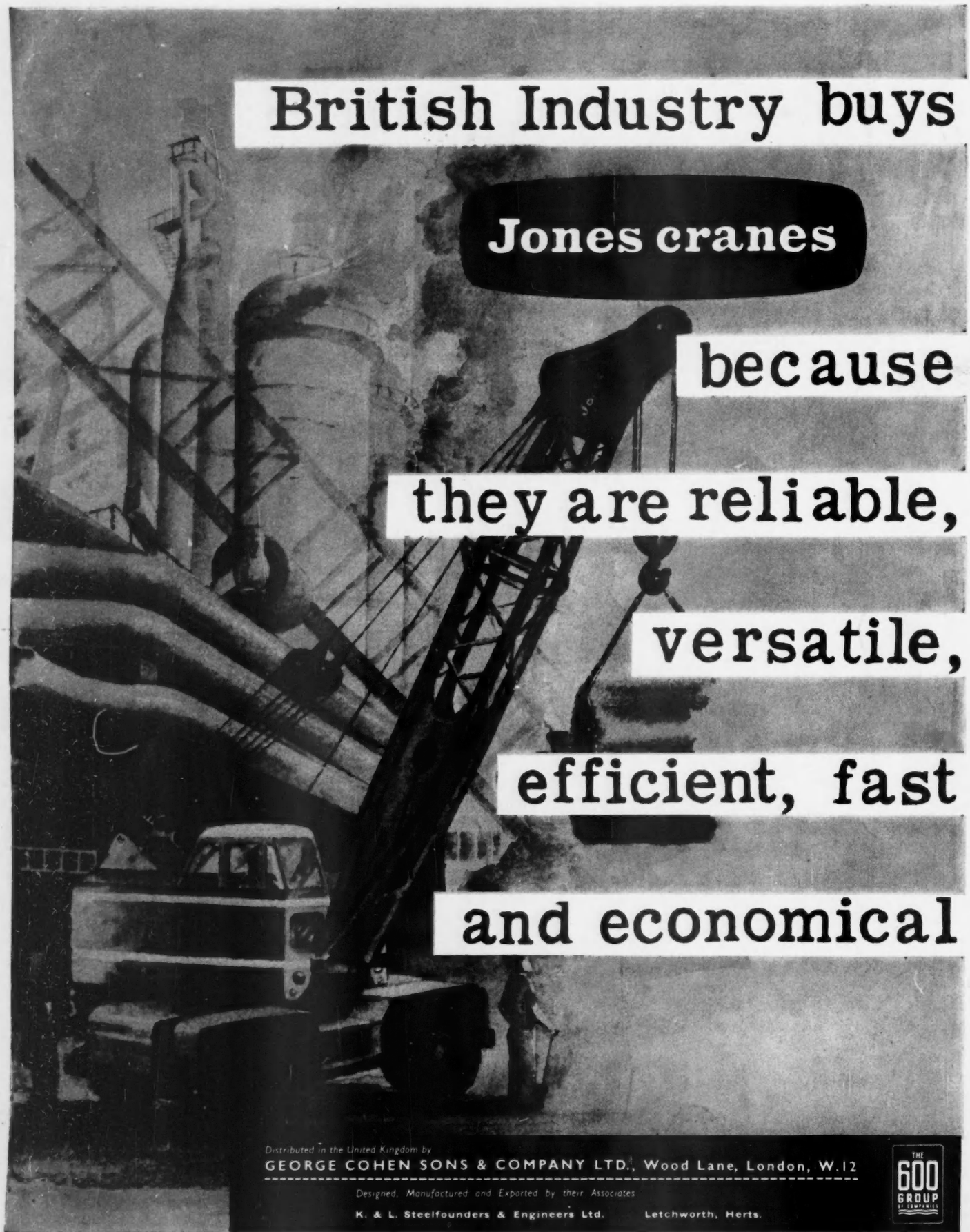
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